THE BEAMA JOURNAL

THE BEAMA JOURNAL

EDITED BY D. N. DUNLOP, A.I.E.E.

VOLUME II.

1916

Published for
THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION (Incorporated)
KING'S HOUSE, KINGSWAY, LONDON, W.C.

CONTENTS

CONTENIDO EN SECCIÓN ESPAÑOLE

MANUFACTURERS' SECTION

LE MEILLEUR VAUT TOUJOURS MIEUX.

Les fabricants qui ont le mieux réussi dans leurs affaires savent, qu'à la fin, les meilleures machines reviennent toujours à meilleur marché. Ils s'informent d'abord de la qualité de la machine, ils la mettent à l'épreuve pour vérifrer la capacité, l'exactitude, et le travail. Lorsqu 'ils sont sûrs d'avoir découvert la meilleure machine ils demandent "Quel en est le Prix?" La première dépense doit être réglée par la qualité. Plusieurs choses sont responsables pour la différence entre les prix des différentes sousmissions, mais les plus importantes sont la qualité du matériel et celle du travail. C'est une mauvaise politique que de choisir l'offre la plus basse sans prendre en considération l'utilité et la durabilité de la machine. C'est la qualité qui fait les hommes et les machines dignes de confiance.

Les vendeurs qui font le prix la base de leur concurrence perdent toujours à la fin, mais l'acheteur qui se laisse tromper par un bas prix perd encore plus.

Si les acheteurs choisissent seulement des marchandises de qualité supérieure ils aideront à faire flotter l'Etendard de la Liberté et du Progrès. S'ils encouragent des bas prix au dépens de la qualité ils ne feront que se préparer une époque de concurrence à outrance qui pourrait facilement aboutir à exterminer et l'acheteur et le vendeur.

Les acheteurs peuvent aider à la cause des Alliés en plaçant leur ordres avec des fabricants anglais, même si la livraison est quelque fois retardée. Si vous avez besoin de moteurs, de matériel, ou de machines électriques, consultez l'almanach de fabriques ("Directory of Manufactures") dans ce journal et écrivez aux membres qui pourvoiront à vos besoins.

IL MIGLIORE VALE SEMPRE PIÙ CHE GLI ALTRI.

I fabbricanti che ottenzono maggior successo, sanno che le macchine migliori sono, dopo tutto, de più a buon mercato. Essi prima s'informano della qualità della macchina, distinguono per la sua efficienza, accuratezza e finitezza di lavoro. Quando hanno trovato la macchina migliore, allora chiedono "Quanto costa?" Il costo iniziale dev'essere regolato dalla qualità. I vari prezzi di costo d'un numero di offerte indicano molte influenze, ma il più importante è la qualità del material e la finitezza del lavoro. E una politica di vistocorta lo scegliere l'offerta più bassa senza considerare l'utilita della macchina per durata coll efficienza.

La fiducia in uomini e macchine dipende dalla qualità.

I venditori che fanno conto sul prezzo come base della loro concorrenza, finiscono col perdere, ma il compratore che si lascia lusingare dal buon mercato perde ancor più.

Se i compratori cercano merce di qualità superiore, contribuiranno a tener alto l'emblema della Libertà e del Progresso. Se incoraggiano il buon mercato a detrimento della Qualità, essi prepareranno un era di acuta competizione che può condurse a mutuo sterminio sia pel compratore che pel venditore.

I compratori ovunque possono ajutare la causa degli alleati, inviando le loro ordinazioni ai fabbricanti inglesi, anche se in certi casi, la consegna è inevitabilmente ritardata.

Chicche vi abbisogna della miglior qualità in generi di Motori d'alto grado, Macchinario elettrico, o congegni consultate l'Annuairio dei Fabbricanti ("Classified Directory of Manufactures") in questo giornale e scrivete ai membri, essi studieramo le vostre richieste.

¿QUIERE UD. LUCHAR VENTAJOSAMENTE CONTRA SUS COMPETIDORES?

Los industriales que logran mayores triunfos en sus respectivas empresas son invariablemente los que tienen el feliz acierto de emplear las mejores máquinas, lo cual les permite fabricar artículos excelentes en corto tiempo, y así venderlos a precios relativamente bajos.

Nuestra dilatada experiencia nos ha demostrado que quienes solicitan presupuestos á varias casas, con el objeto de favorecer á la que venda máquinas de más bajo precio, son hostiles á sus intereses, porque una máquina de $100, por ejemplo, dura notablemente menos que otra similar de $150, exige mayores desembolsos en reparaciones, y produce un trabajo que está muy lejos de igualarse al de esta última. Por otra parte, como los gastos de producción son más elevados, el artículo cuesta más al consumidor, sin ser por ello tan bueno como el que produce la máquina de calidad superior.

Por lo tanto, si quiere Ud. luchar ventajosamente contra sus competidores, ensanchar su campo de acción, y al propio tiempo fomentar el progreso de la industria, es obvio que debe Ud. anteponer la buena calidad al precio; en otros términos no se diga Ud. jamás: "¿Es esta la máquina más barata que puedo comprar?"; sino "¿Es esta la mejor máquina que puedo adquirir?", y luego "¿Es su precio razonable?".

El lema de todo industrial inteligente ha de ser: Lo mejor es siempre barato; lo malo es siempre caro á cualquier precio.

En el DIRECTORIO DE FABRICANTES ("Directory of Manufactures") que insertamos en esta revista encontrará Ud. nombres de casas de confianz que venden artículos inmejorablesa, a precios equitativos. No vacile Ud. en dirigirse á ellas siempre que necesite algo en los ramos que allí se mencionan: será Ud. atendido con el mayor cuidado, y sus pedidos despachados en el menor tiempo posible. Es cierto que en algunos casos tendrá Ud. que aguardar un poco, debido á las condiciones creadas por esta malhadada guerra; pero hallará Ud. amplia compensación en la excelencia y relativa baratura de las mercancías que Ud. adquiera de nuestros socios.

TOME UD. NOTA DE LAS CASAS QUE LE INTERESEN, Y ESCRÍBALES EN SEGUIDA. CUANTO ANTES LO HAGA, TANTO MEJOR PARA USTED!

ЛУЧШЕЕ ЕСТЬ ЛУЧШЕЕ.

Фабриканты, достигшіе наибольшихъ успѣховъ, знаютъ, что самыя лучшія машины, въ концѣ концовъ, оказываются и самыми дешевыми. Они освѣдомляются прежде всего о качествѣ машины, они испытываютъ ея производительность, точность и чистоту работы. Послѣ того, какъ они нашли наилучшую машину, они спрашиваютъ „сколько она стоитъ."

Первоначальная стоимость должна опредѣляться качествомъ. Различныя расцѣнки въ извѣстномъ числѣ предложеній составляются подъ вліяніемъ многихъ факторовъ, изъ которыхъ главное значеніе имѣетъ достоинство матеріаловъ и работы. Было бы очень близорукою политикою остановиться на предложеніи съ самою низкою цѣною безъ отношенія къ вѣроятной продоложительности службы машины и ея производительности.

Надежность въ службѣ какъ людей, такъ и машинъ опредѣляется ихъ достоинствами.

Продавцы, конкуррирующіе исключительно низкими цѣнами, въ концѣ концовъ терпятъ неудачу, но покупатель, который даетъ ввести себя въ заблужденіе дешевизною, теряетъ еще больше.

Если покупатели будутъ давать предпочтеніе товарамъ лучшаго качества, то они въ то же время будутъ содѣйствовать и побѣдѣ свободы и прогресса. Если они будутъ поддерживать политику низкихъ цѣнъ за счетъ качества, то этимъ подготовятъ наступленіе эры недобросовѣстной конкурренціи которая въ концѣ концовъ погубитъ и покупателей и продавцовъ.

Покупатели во всѣхъ странахъ свѣта могутъ помочь общему дѣлу Четверного Согласія, предоставляя свои заказы Британскимъ фабрикамъ и заводамъ, даже если, въ томъ или другомъ случаѣ, это будетъ сопряжено съ нѣкоторымъ промедленіемъ въ сдачѣ.

Если Вамъ требуется что-либо высокаго качества въ области движителей, электрическихъ машинъ или принадлежностей, просмотрите списокъ адресовъ фабрикантовъ и заводчиковъ, указанный въ этомъ журналѣ, и пошлите Ваши запросы членамъ нашей ассоціаціи.

Они отнесутся съ полнымъ вниманіемъ къ Вашимъ потребностямъ.

THE BEAMA JOURNAL

Vol. II No. 1 JANUARY 1916

CONTENTS

CLASSIFIED DIRECTORY OF MANUFACTURES

MANUFACTURES OF MEMBERS. PRODUCTIONS DES ASSOCIES. PRODUCCIONES DE LOS SOCIOS
ПРОИЗВОДСТВА УЧАСТВУЮЩИХЪ ФИРМЪ.

ACCESSORIES for Power, Lighting, Bells and Signalling.
ACCESSOIRES pour Force Motrice, Eclairage, Sonneries et Signaux.
ACCESORIOS para Fuerza Motriz, Alumbrado, Campanillas y Señales.
ПРИНАДЛЕЖНОСТИ для Двигателей, Освѣщенія, Звонковъ и Сигналовъ.

Bells (for bell wires, see under " Wires ").
Sonneries (pour fils de sonneries, voir " Fils ").
Campanillas (para alambres de campanillas, véase " Alambres ").
Звонки (звонк. провода, см. ,,Провода").

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
GENERAL ELECTRIC CO., LTD
SIEMENS BROS. & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Casing and Capping.
Moulures pour Fils.
Cajetines para Alambres.
Ройки для Проводовъ.

BERRY, SKINNER & CO.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Roses.
Rosaces de Plafond.
Rosetones de Techo.
Потолочныя Розетки.

BERRY, SKINNER & CO.
ELECTRIC ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Cut-outs.
Coupe-Circuits.
Cortacircuitos.
Предохранители.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD
ECKSTEIN, HEAP & CO, LTD
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
GENERAL ELECTRIC CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
IGRANIC ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO., LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Indicators.
Indicateurs.
Indicadores.
Индикаторы.

BERRY, SKINNER & CO
GENERAL ELECTRIC CO., LTD.
NALDER BROS. & THOMPSON, LTD.
REASON MANUFACTURING CO., LTD.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO., LTD.

Lampholders.
Douilles.
Portalámparas.
Натроны.

BERRY, SKINNER & CO.
DAY, ST. JOHN (PATENTS), LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Plugs and Sockets.
Fiches et Prises de Courant.
Llaves y Cajas de Contacto.
Контачныя Штепселя и Коробки.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
DAY, ST. JOHN (PATENTS), LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO., LTD.

Pushes.

Boutons de Poussoirs.

Botones de Llamada.

Звонковыя Кнопки.

BERRY, SKINNER & CO.
GENERAL ELECTRIC CO., LTD
IGRANIC ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD

Tumbler Switches.

Interrupteurs à Boule.

Llaves de Concha.

Выключатели съ опрок. головкой.

BERRY, SKINNER & CO.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO. LTD.

Wood Blocks.

Tampons en Bois.

Tacos de Madera.

Деревянные Закрѣпы.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Accessories for accumulators, arc lamps, batteries, telephones, etc., see under those headings.

Accessoires pour accumulateurs, lampes à arc, batteries, téléphones, etc., voir ces mots.

Accesorios para acumuladores, lámparas de arco, baterías, teléfonos, etc., véanse estas palabras.

Принадлежности для аккумуляторовъ, дуговыхъ лампъ, батарей, телефоновъ, и пр., см. эти слова.

ACCUMULATORS.

ACCUMULATEURS.

ACUMULADORES.

АККУМУЛЯТОРЫ.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
D.P. BATTERY CO., LTD.
TUDOR ACCUMULATOR CO., LTD.
PRITCHETTS & GOLD AND ELECTRIC POWER STORAGE CO., LTD.

Accumulator Switches and Switchboards, see under "Switchgear."

Commutateurs et Tableaux de Distribution pour Accumulateurs, voir "Appareils de Distribution."

Conmutadores y Cuadros de Distribución para Acumuladores, véase "Aparatos de Distribución."

Аккумуляторные Коммутаторы и Распредѣлительныя доски, см. „Распредѣлительныя Устройства".

ACCUMULATORS (Heat, Regenerative).

ACCUMULATEURS de Chaleur Régénérative.

ACUMULADORES de Calor Regenerativo.

АККУМУЛЯТОРЫ Регенеративаго Тепла.

RICHARDSONS WESTGARTH & CO., LTD.

AIR COMPRESSORS, see "Compressors."

COMPRESSEURS d'AIR, voir "Compresseurs."

COMPRESORES de AIRE, véase "Compresores."

ВОЗДУШНЫЕ КОМПРЕССОРЫ, см. „Компрессоры".

AIR FILTERS.

Filtres d'Air.

Filtros de Aire.

Воздушные Фильтры.

PREMIER COOLER & ENGINEERING CO., LTD

ALTERNATORS, see "Generators."

ALTERNATEURS, voir "Génératrices."

ALTERNADORES, véase "Generadores."

АЛЬТЕРНАТОРЫ, см. „Генераторы".

ARC LAMPS and Accessories.

LAMPES à ARC et Accessoires.

LAMPARAS de ARCO y Accesorios.

ДУГОВЫЯ ЛАМПЫ или ФОНАРИ и Принадлежности.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Standards.

Poteaux de Lampes à Arc.

Columnas de Lámparas de Arco.

Столбы для Дуговыхъ Лампъ.

BERRY, SKINNER & CO
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Winches.

Treuils de Levage pour Lampes à Arc.

Tornos de Elevación para Lámparas de Arco.

Лебедки для Дуговыхъ Лампъ.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD

Arc Lamp Carbons, see under "Carbons."
Crayons de Lampes à Arc, voir "Crayons."
Carbones para Lámparas de Arco, véase "Carbones"
Угли для Дуговыхъ Лампъ, см. „Угли"

Arc Lamp Globes, see under "Glassware."
Globes de Lampes à Arc, voir "Verreries."
Globos de Lámpara de Arco, véase "Cristalería"
Шары для Дуговыхъ Лампъ, см. „Стеклянная Посуда".

AUTOMOBILE SWITCHBOARDS.
TABLEAUX de DISTRIBUTION pour AUTOMOBILES.
CUADROS de DISTRIBUCION para AUTOMOVILES.
КОММУТАЦIОННЫЯ ДОСКИ для АВТОМОБИЛЕЙ.

LUNDBERG, A. P., & SONS.

BATTERIES, Primary and Accessories.
BATTERIES, Primaires et Accessoires.
BATERIAS, Primarias y Accesorios.
БАТАРЕИ Первичныя и Принадлежности

Dry Cells.
Piles Sèches.
Pilas Secas.
Сухіе Элементы.

GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD,
SIEMENS BROS. & CO., LTD.
SUN ELECTRICAL CO., LTD

Ignition Cells.
Piles d'Allumage.
Pilas de encender.
Зажигательныя Батареи.

GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Wet Cells (Leclanché, etc.).
Piles Hydroélectriques (Leclanché, etc.).
Pilas Hidroeléctricas (Leclanché, etc.).
Мокрые Элементы (Лекланше и др.).

GENERAL ELECTRIC CO., LTD
SIEMENS BROS. & CO., LTD

BELLS, see under "Accessories."
SONNERIES, voir "Accessoires."
CAMPANILLAS, véase "Accessorios."
ЗВОНКИ, см. „Принадлежности".

BLOWERS, see COMPRESSORS.
SOUFFLERIES, voir **COMPRESSEURS.**
SOPLADORES, véase **COMPRESORES.**
ВОЗДУХОДУВКИ, см. **КОМПРЕССОРЫ.**

BOILERS and Boiler Equipments.
CHAUDIERES et Accessoires de Chaudières.
CALDERAS y Accesorios de Calderas.
КОТЛЫ и Котельная Арматура.

CLARKE, CHAPMAN & CO., LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD
RICHARDSONS, WESTGARTH & CO., LTD

BOOSTERS, see under "Generators."
SURVOLTEURS, voir "Génératrices."
ELEVADORES de TENSION, véase "Generadores."
ПОВЫСИТЕЛИ НАПРЯЖЕНIЯ (БУСТЕРЫ), см. „Генераторы".

BRAKES (Magnetic).
FREINS Magnétiques.
FRENOS Magnéticos.
Магнитные ТОРМАЗА.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.

BRUSHES, Carbon, for Electrical Machinery.
BALAIS en Carbone pour Appareils Electriques
ESCOBILLAS de Carbón para Aparatos Eléctricos.
УГОЛЬНЫЯ ЩЕТКИ для Электрическихъ Машинъ.

MORGAN CRUCIBLE CO., LTD.

CABLES (see also "Wires") and Cable Accessories.
CÂBLES (voir aussi "Fils") et Accessoires de Câbles.
CABLES (véase también "Alambres") y Accesorios de Cables.
КАБЕЛИ (см. также „Провода") и Принадлежности.

Paper Insulated Cables.
Câbles Isolés au Papier.
Cables Aislados con Papel.
Кабели съ Бумажной Изоляцiей.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD
HENLEY'S, W. T., TELEGRAPH WORKS, LTD
JOHNSON & PHILLIPS, LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Rubber Insulated Cables.
Câbles Isolés au Caoutchouc.
Cables Aislados con Caucho.
Кабели съ Резиновой Изоляцiей.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Submarine Cables.
Câbles Sous-Marins.
Cables Submarinos.
Подводные Кабели.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD

Telephone Cables.
Câbles Téléphoniques.
Cables Telefónicos.
Телефонные Кабели.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GENERAL ELECTRIC CO., LTD
GLOVER, W T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Junction Boxes.
Boîtes de Dérivation.
Cajas de Derivación.
Отвѣтвительныя Коробки.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
LUCY, W., & CO.
SIEMENS BROS. & CO., LTD

Expansion Joints.
Joints Extensibles.
Empalmes Extensibles.
Растяжимыя Соединенія.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD
GLOVER, W T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. & CO., LTD.

CARBONS.
CHARBONS.
CARBONES.
УГЛИ.

For Arc Lamps.
Pour Lampes à Arc.
Para Lámparas de Arco.
Для Дуговыхъ Лампъ.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD
SIEMENS BROS. & CO., LTD.

Carbon Brushes, see under "Brushes."
Balais en Carbone, voir "Balais."
Escobillas de Carbón, véase "Escobillas."
Угольныя Щетки, см. „Щетки".

Carbon Crucibles, see under "Crucibles."
Creussets en Carbone, voir "Creusets."
Crisoles de Carbón, véase "Crisoles."
Тигли Угольные, см. „Тигли".

CEILING ROSES, see under "Accessories."
ROSACES DE PLAFOND, voir "Accessoires."
ROSETONES DE TECHO, véase "Accesorios."
ПОТОЛОЧНЫЯ РОЗЕТКИ, см. „Принадлежности".

CELLS, see "Accumulators" and "Batteries."
PILES, voir "Accumulateurs" et "Batteries."
PILAS, véase "Acumuladores" y "Baterías."
ЭЛЕМЕНТЫ, см. „Аккумуляторы" и „Батареи"

CLOCKS, Electrically driven.
HORLOGES Electriques.
RELOJES Eléctricos.
ЧАСЫ Электрическіе.

ARON ELECTRICITY METER, LTD
VENNER & CO.

COLLIERIES, Equipment of, see "Mines."
HOUILLERES, Equipements de, voir "Mines."
HULLERAS, Equipos de, véase "Minas."
КАМЕННОУГОЛЬНЫЯ КОПИ, ихъ оборудованіе, см. „Рудники".

COMPRESSORS AND BLOWERS.
COMPRESSEURS et SOUFFLERIES.
COMPRESORES y SOPLADORES.
КОМПРЕССОРЫ и ВОЗДУХОДУВКИ.

ALLEN, W. H., SON & CO., LTD.
ALLEY & MACLELLAN, LTD
BELLISS & MORCOM LTD.
BRITISH THOMSON HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
BROWETT, LINDLEY & CO., LTD.
FRASER & CHALMERS, LTD.
PARSONS, C. A., & CO., LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

CONDENSERS, ELECTRICAL.
CONDENSATEURS ELECTRIQUES.
CONDENSADORES ELECTRICOS.
КОНДЕНСАТОРЫ ЭЛЕКТРИЧЕСКІЕ.

BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
GENERAL ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
SIEMENS BROS & CO., LTD.

CONDENSERS, STEAM.
CONDENSEURS de VAPEUR.
CONDENSADORES de VAPOR.
КОНДЕНСАТОРЫ ПАРОВЫЕ.

ALLEN, W. H., SON & CO., LTD.
ASHWORTH & PARKER.
BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CLARKE, CHAPMAN & CO., LTD.
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD
WORTHINGTON PUMP CO., LTD.

CONDUITS and Conduit Fittings.
TUBES ISOLANTS et Accessoires pour Tubes.
TUBOS AISLADORES y Accesorios para Tubos.
ИЗОЛЯЦIОННЫЯ ТРУБКИ и ихъ Принадлежности.

CREDENDA CONDUITS CO. LTD.
GENERAL ELECTRIC CO. LTD.
SIEMENS BROS. DYNAMO WORKS LTD.

CONTROL GEAR.
APPAREILS CONTROLEURS.
APARATOS DE COMPROBACION.
КОНТРОЛЬНЫЕ АППАРАТЫ.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM-REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTRIC CONTROL LTD. (Automatic Control Gear only).
ELECTRICAL APPARATUS CO., LTD.
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO. LTD.
JOHNSON & PHILLIPS, LTD.
REYROLLE & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
WEST, ALLEN, & CO., LTD.
WHIPP & BOURNE.

Controllers for Crane Motors.
Contrôleurs pour Moteurs de Grues.
Controleres para Motores de Grúas.
Контролеры для Крановыхъ Моторовъ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO. LTD
ELLISON, GEORGE.
IGRANIC ELECTRIC CO., LTD.
WEST, ALLEN, & CO. LTD

Controllers for Traction Work.
Contrôleurs pour Moteurs de Tramway.
Controleres para Motores de Tranvía.
Контролеры для Трамвайныхъ Моторовъ.

BRITISH THOMSON-HOUSTON CO. LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO. LTD
DICK, KERR & CO., LTD
ECKSTEIN, HEAP & CO., LTD.
ELLISON, GEORGE.
SIEMENS BROS. DYNAMO WORKS, LTD
WEST, ALLEN, & CO LTD

Motor Starters and Panels.
Démarreurs et Tableaux de Démarrage pour Moteurs.
Aparatos y Cuadros de Arranque para Motores.
Пусковые Аппараты и Доски для Моторовъ.

BERRY, SKINNER & CO
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM & REISS, LTD
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD
BRUSH ELECTRICAL ENGINEERING CO. LTD
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELLISON, GEORGE.
FERRANTI, LTD
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MORRIS & LISTER, LTD.
REYROLLE, A., & CO. LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Rheostats.
Rhéostats.
Reostatos.
Реостаты.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD
BRUSH ELECTRICAL ENGINEERING CO., LTD
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO, LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD
ELECTRICAL APPARATUS CO, LTD
ELECTRIC & ORDNANCE ACCESSORIES CO. LTD
ELLIOTT BROTHERS
ELLISON, GEORGE
FERRANTI, LTD
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD
MAVOR & COULSON, LTD.
NALDER BROS. & THOMPSON LTD.
PAUL, ROBERT W.
REYROLLE, A., & CO, LTD
SIEMENS BROS DYNAMO WORKS LTD
SWITCHGEAR & COWANS, LTD
WEST, ALLEN, & CO., LTD.
WHIPP & BOURNE.

CONVERTERS (Motor).
TRANSFORMATEURS en CASCADE
TRANSFORMADORES en CASCADA
КАСКАДНЫЕ КОНВЕРТЕРЫ

(PEEBLES—LA COUR PATENTS)
PEEBLES, BRUCE, & CO, LTD

CONVERTERS, ROTARY.
COMMUTATRICES.
CONVERTIDORES ROTATORIOS.
ВРАЩАЮЩІЕСЯ КОНВЕРТЕРЫ (ПРЕОБРАЗОВАТЕЛИ).

BOOTHROYD, H. T. LTD
BRITISH ELECTRIC PLANT CO, LTD
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO LTD.
CROMPTON & CO., LTD
DICK, KERR & CO., LTD
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.
WRIGHT & WOOD, LTD.

Converters, Static, see "Transformers."
Transformateurs Statiques, voir "Transformateurs."
Transformadores Estáticos, véase "Transformadores."
Статическіе Преобразователи, см. ,,Трансформаторы".

COOKING APPLIANCES, ELECTRICAL, see "Heating and Cooking."
USTENSILES ELECTRIQUES de CUISINE, voir "Chauffage et Cuisine."
UTENSILIOS ELECTRICOS de COCINA, véase "Caldeo y Cocina."
ЭЛЕКТРИЧЕСКІЕ КУХОННЫЕ ПРИБОРЫ, см. ,,Отопленіе и Кухонные Приборы".

CRANE EQUIPMENTS, see also "Control Gear," "Motors," etc.
EQUIPEMENT DE GRUES, voir aussi "Appareils Contrôleurs," "Moteurs," etc.
EQUIPOS DE GRUAS, véase también "Aparatos de Comprobación." Motores," etc.
СНАРЯЖЕНІЕ для КРАНОВЪ, см. также ,,Контрольные Аппараты", ,,Моторы" и пр.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
ELLISON, GEORGE.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
WEST, ALLEN & CO., LTD.

CRUCIBLES, Electric.
CREUSETS Electriques.
CRISOLES Eléctricos.
ТИГЛИ Электрическіе.

MORGAN CRUCIBLE CO., LTD.

CUT-OUTS, see "Accessories."
COUPE-CIRCUITS, voir "Accessoires."
CORTACIRCUITOS, véase "Accesorios."
ПРЕДОХРАНИТЕЛИ, см. ,,Принадлежности".

DISTRIBUTION BOARDS, see also "Switchgear."

TABLEAUX DE DISTRIBUTION, voir aussi "Appareils de Distribution."

CUADROS DE DISTRIBUCION, véase también "Aparatos de Distribución."

РАСПРЕДѢЛИТЕЛЬНЫЯ ДОСКИ, см. также „Распредѣлительныя Устройства".

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
SWITCHGEAR & COWANS, LTD.

DOMESTIC APPLIANCES, see also "Heating and Cooking." "Fans," etc.

APPAREILS DOMESTIQUES, voir aussi "Chauffage et Cuisine." "Ventilateurs," etc.

APARATOS DOMESTICOS, véase también "Caldeo y Cocina," "Ventiladores," etc.

ДОМОВЫЯ УСТАНОВКИ, см. также „Отопление и Освѣщение", „Вентиляторы" и пр.

BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
SUN ELECTRICAL CO., LTD.

Vacuum Cleaners.
Nettoyeuses au Vide.
Limpiadores de Vacio.
Пылесосы.

DRILLS, Electrically driven.

FOREUSES Electriques.

PERFORADORES Eléctricos.

Электрическіе СВЕРЛИЛЬНЫЕ СТАНКИ.

BOOTHROYD, H. T., LTD.
REES, ROTURBO MANUFACTURING CO., LTD

Portable Drilling Machines.
Foreuses Portatives.
Perforadores Portátiles.
Переносные Сверлильные Станки.

BOOTHROYD, H. T., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
REES ROTURBO MANUFACTURING CO., LTD.

DYNAMOS, see "Generators."

DYNAMOS, voir "Génératrices."

DINAMOS, véase "Generadores."

ДИНАМО, см. „Генераторы".

ENGINES, see "Prime Movers."

MACHINES, voir "Machines Motrices."

MAQUINAS, véase "Máquinas Motoras."

ДВИГАТЕЛИ, см. это слово.

FANS.

VENTILATEURS.

VENTILADORES.

ВЕНТИЛЯТОРЫ.

Bracket Fans.
Ventilateurs à Console.
Ventiladores de Consola.
Консольные Вентиляторы.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Fans.
Ventilateurs de Plafond.
Ventiladores de Techo.
Потолочные Вентиляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO.
SUN ELECTRICAL CO., LTD.

Table Fans.
Ventilateurs de Table.
Ventiladores de Mesa.
Настольные Вентиляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.

PARSONS C A., & CO
SUN ELECTRICAL CO., LTD

Ventilating Fans.
Ventilateurs Extracteurs.
Ventiladores Extractores.
Вытяжные Вентиляторы.

ALLEN, W. H., SON & CO., LTD
BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
HOWDEN, JAMES & CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

FITTINGS for Electric Light.
ACCESSOIRES pour Lumière Electrique.
ACCESORIOS para Luz Eléctrica.
ПРИНАДЛЕЖНОСТИ для Электрическаго Свѣта.

Brackets.
Appliques.
Brazos.
Кронштейны.

BRITISH THOMSON-HOUSTON CO., LTD
CREDENDA CONDUITS CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Fittings.
Accessoires de Plafond.
Accesorios de Techo.
Потолочныя Гарнитуры.

BRITISH THOMSON-HOUSTON CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Counterweights.
Contrepoids.
Contrapesos.
Противовѣсы.

BRITISH THOMSON-HOUSTON CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Electroliers.
Lustres.
Arañas.
Люстры.

BRITISH THOMSON-HOUSTON CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Fancy Shades.
Abat-Jour Artistiques.
Pantallas Artisticas.
Декоративные Абажуры.

BRITISH THOMSON-HOUSTON CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO., LTD

Hand Lamps.
Lampes à Main.
Lámparas de Mano.
Ручныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD
DAY, ST. JOHN, (PATENTS), LTD
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD
SIEMENS BROS. DYNAMO WORKS LTD.

Lanterns.
Lanternes.
Linternas.
Фонари.

BRITISH THOMSON-HOUSTON CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO. LTD.

Pendants.
Lampes à Suspension.
Lámparas de Suspensión.
Подвѣсныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
GENERAL ELECTRIC CO., LTD
PARK ROYAL ENGINEERING WORKS, LTD
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO., LTD

Reflectors.
Reflecteurs.
Reflectores.
Рефлекторы.

BRITISH THOMSON-HOUSTON CO., LTD
CLARKE, CHAPMAN & CO., LTD
DAY, ST. JOHN, (PATENTS), LTD.
GENERAL ELECTRIC CO., LTD
PARK ROYAL ENGINEERING WORKS, LTD
PARSONS, C. A., & CO., LTD.
REASON MANUFACTURING CO., LTD
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO., LTD.

Standard Lamps.
Lampes Portatives.
Lámparas Portátiles.
Переносныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
GENERAL ELECTRIC CO., LTD.

SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Street Fittings.
Matériel pour Eclairage Public.
Material para Alumbrado Público.
Матеріалъ для Уличнаго Освѣщенія.

BRITISH THOMSON-HOUSTON CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Watertight Fittings for Mines, Dockyards, Shipwork, etc.
Accessoires Hermétiques pour Mines, Chantiers de Construction Navale, Navires, etc.
Accesorios Herméticos para Minas, Astilleros Buques, etc.
Водонепроницаемыя Устройства для Рудниковъ, Верфей, Судовъ и пр.

BRITISH THOMSON-HOUSTON CO., LTD.
GENERAL ELECTRIC CO LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Carbons for Electric Furnaces, see " Carbons."
Electrodes pour Fours Electriques, voir " Crayons."
Electrodes para Hornos Eléctricos, véase " Carbones,"
Электроды для Электрическихъ Печей, см. „Угли".

FUSES.
FUSIBLES.
FUSIBLES.
ЛЕГКО-ПЛАВКІЯ ВСТАВКИ.

BERRY, SKINNER & CO.
BRITISH THOMSON HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
CROMPTON & CO., LTD
ELECTRIC CONTROL, LTD. (High Tension)
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ECKSTEIN, HEAP & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
LUCY, W., & CO., LTD.
NALDER BROS. & THOMPSON LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REASON MANUFACTURING CO., LTD
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

GENERATORS, A.C. and D.C.
GENERATRICES, à C.C. et à C.A.
GENERADORES, de C.C. y C.A.
ГЕНЕРАТОРЫ Пост. и Перем. Тока.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD
DICK, KERR & CO., LTD
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD
MAWDSLEY'S, LTD.
PARSONS, C A., & CO.
PEEBLES, BRUCE, & CO., LTD
PHŒNIX DYNAMO MANUFACTURING CO., LTD
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD
VICKERS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD

Boosters.
Survolteurs.
Elevadores de Tensión.
Новысители Напряженія (Бустеры).

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Generators for Electro-Plating.
Génératrices pour Galvanoplastie.
Generadores para Galvanoplastia.
Генераторы для Гальванопластики.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.

GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Motor-Generators.
Moteurs-Générateurs.
Motores-Generadores.
Двигатели-Генераторы.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Turbo-Alternators.
Turbo-Alternateurs.
Turbo-Alternadores.
Турбо-Альтернаторы.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELEC. & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD
PEEBLES, BRUCE, & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Continuous Current Turbo-Generators.
Turbo-Génératrices à Courant Continu.
Turbo-Dinamos de Corriente Continua.
Турбо-Генераторы Пост. Тока.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
MATHER & PLATT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

GLASSWARE.
VERRERIES.
CRISTALERIA.
СТЕКЛЯННАЯ ПОСУДА.

Arc Lamp Globes.
Globes de Lampes à Arc.
Globos de Arco.
Шары для Дуговыхъ Лампъ.

Glass Shades.
Abat-Jour en Verre.
Pantallas de Vidrio.
Стеклянные Абажуры.

Holophane Ware.
Verreries Holophanes.
Cristaleria Holófana.
Голофанная Посуда.
MOST MEMBERS OF THE B.E.A.M.A. SELL THESE WARES.

HEATING AND COOKING APPLIANCES, Electrical.
APPAREILS Electriques de **CHAUFFAGE** et de **CUISINE.**
APARATOS Eléctricos de **CALDEO** y de **COCINA.**
Электрическіе **НАГРѢВАТЕЛЬНЫЕ и КУХОННЫЕ ПРИБОРЫ.**
CREDENDA CONDUITS CO., LTD.
BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO. LTD
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
FERRANTI, LTD
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

Radiators, see this word under main headings.
Radiateurs, voir ce mot.
Radiadores, véase esta palabra.
Радіаторы, см. это слово.

INCANDESCENT LAMPS, see "Lamps."
LAMPES à INCANDESCENCE, voir "Lampes."
LAMPARAS de INCANDESCENCIA, véase "Lámparas."
ЛАМПЫ НАКАЛИВАНІЯ, см. „Лампы".

INDUCTION COILS, see "Medical Electro-Appliances" and "Wireless Telegraphy Appliances."
BOBINES d'INDUCTION, voir "Appareils Electro-Médicaux" et "Appareils de Télégraphie sans Fil."
CARRETES de INDUCCION, véase "Aparatos Eléctro-Medicales" y "Aparatos de Telegrafía sin Alambres."
ИНДУКЦІОННЫЯ КАТУШКИ, см. „Электро-Медицинскіе Аппараты" и „Радіо-Телеграфные Аппараты".

INSTRUMENTS, see also "Testing Sets."
INSTRUMENTS, voir aussi "Appareils de Laboratoire."
INSTRUMENTOS, véase también "Aparatos de Laboratorio."
ИНСТРУМЕНТЫ, см. также „Приборы для Испытанія".

Indicating Instruments (Ammeters, Voltmeters, Wattmeters, Phasemeters, Frequency Indicators, etc.).
Instruments de Mesure (Ampèremètres, Voltmètres, Wattmètres, Phasemètres, Fréquencemètres, etc.).
Instrumentos de Medida (Amperómetros, Voltimetros, Vatímetros, Fasómetros, Frecuencímetros, etc.).

Контрольные Аппараты (Амперметры, Вольтметры, Ваттметры, Фазометры, Частометры и др.).

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD
ECKSTEIN, HEAP & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD
EVERSHED & VIGNOLES, LTD.
FERRANTI, LTD
GENERAL ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD
SIEMENS BROS. & CO., LTD.

Instrument Transformers.
Transformateurs de Mesure.
Transformadores de Medida.
Измѣрительные Трансформаторы.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD
REYROLLE, A., & CO., LTD.
SWITCHGEAR & COWANS, LTD

Recording Instruments.
Instruments Enregistreurs.
Instrumentos Registradores.
Самопишущіе Приборы.

BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ECKSTEIN HEAP & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
GENERAL ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.

Instruments, Integrating, see "Meters."
Compteurs Totalisateurs, vior "Compteurs."
Contadores Integradores, véase "Contadores."
Счетчики-Интеграторы, см. ,,Счетчики".

INSULATORS.
ISOLATEURS.
AISLADORES.
ИЗОЛЯТОРЫ.

Porcelain Insulators.
Isolateurs en Porcelaine.
Aisladores de Porcelana.
Фарфоровые Изоляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
IGRANIC ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Suspension Insulators.
Isolateurs de Suspension.
Aisladores de Suspensión.
Подвѣсные Изоляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
SIEMENS BROS. & CO., LTD.

Tramway Insulators for Overhead Lines.
Isolateurs de Tramway pour Lignes Aériennes
Aisladores de Tranvia para Lineas Aéreas.
Изоляторы для Трамвайныхъ Воздушныхъ Линій.

BRITISH INSULATED & HELSBY CABLES, LTD
BRITISH THOMSON-HOUSTON CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD

INSULATING MATERIAL.
MATIERES ISOLANTES.
MATERIALES AISLANTES.
ИЗОЛЯЦІОННЫЕ МАТЕРІАЛЫ.

Press Spahn and other Materials.
Cartons Comprimés et autres Matières
Cartones Comprimidos y otros Materiales.
Прессованные Картоны и др. Матеріалы.

BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
DAY, ST. JOHN (PATENTS), LTD
ECKSTEIN, HEAP & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO. LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD
PARK ROYAL ENGINEERING WORKS, LTD.
PIRELLI, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

JUNCTION BOXES, see "Cables" and "Conduits."

BOITES de DERIVATION, voir "Cables" et "Tubes Isolants."

CAJAS de DERIVACION, véase "Cables" y "Tubos Aisladores."

ОТВѢТВИТЕЛЬНЫЯ КОРОБКИ, см. „Кабели" и „Изоляц. Трубки".

LAMPS, see also "Arc Lamps."

LAMPES, voir aussi "Lampes à Arc."

LAMPARAS, véase también "Lámparas de Arco."

ЛАМПЫ, см. также „Дуговыя Лампы".

Incandescent Lamps (Carbon Filament, Metallic Filament, and Drawn Wire Lamps).

Lampes à Incandescence (à Filament en Carbone, à Filament Métallique et à Fil Etiré).

Lámparas de Incandescencia (con Filamento de Carbón, Filamento metálico, y con Alambre Estirado).

Лампы Накаливанія (съ Угольной Нитью, Металлической Нитью и съ Тянутой Проволокой).

BRITISH THOMSON-HOUSTON CO., LTD.
DICK, KERR & CO., LTD
GENERAL ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD
OSRAM-ROBERTSON LAMP WORKS, LTD.
SIEMENS BROS. & CO., LTD.
SIEMENS BROS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD

LAMPHOLDERS, see "Accessories."

DOUILLES, voir "Accessoires."

PORTALAMPARAS, véase "Accesorios."

ПАТРОНЫ, см. „Принадлежности".

LANTERNS, see "Fittings."

LANTERNES, voir "Garnitures."

LINTERNAS, véase "Guarniciones."

ФОНАРИ, см. „Гарнируры".

LIFT MOTORS, see "Motors."

Moteurs d'Ascenseurs, voir "Moteurs."

Motores para Ascensores, véase "Motores"

Подъемные Моторы, см. „Моторы".

LIGHTNING ARRESTERS.

PARAFOUDRES.

PARARRAYOS.

ГРОМООТВОДЫ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EVERETT, EDGCUMBE & CO. LTD
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD

MAGNETOS.

MAGNÉTOS.

MAGNETOS.

МАГНЕТА.

BRITISH THOMSON-HOUSTON CO. LTD

MAGNETS, LIFTING.

ELECTRO-AIMANTS.

ELECTRO-IMANES.

ЭЛЕКТРО-МАГНИТЫ.

ECKSTEIN HEAP & CO., LTD
ELECTRIC CONTROL LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
MORRIS & LISTER, LTD.
PARK ROYAL ENGINEERING WORKS, LTD

MAGNETS, PERMANENT.

AIMANTS PERMANENTS.

IMANES PERMANENTES.

ПОСТОЯННЫЕ МАГНИТЫ.

NALDER BROS. & THOMPSON, LTD
PARK ROYAL ENGINEERING WORKS LTD

MEDICAL, ELECTRO-APPLIANCES.

APPAREILS ELECTRO-MEDICAUX.

APARATOS ELECTRO-MEDICALES.

ЭЛЕКТРО-МЕДИЦИНСКІЕ АППАРАТЫ

Induction Coils.

Bobines d'Induction.

Carretes de Inducción.

Индукціонныя Катушки.

BRITISH THOMSON-HOUSTON CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

X-Ray Outfits.

Radiomètres pour Rayons X.

Radiómetros para Rayos Roentgen.

Приборы для Рентгеновскихъ Лучей.

BRITISH THOMSON-HOUSTON CO., LTD.
SIEMENS BROS. & CO., LTD.

METERS

COMPTEURS.

CONTADORES.

СЧЕТЧИКИ.

ARON ELECTRICITY METER, LTD.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

Ampère-Hour Meters.
Ampères-Heures-Mètres.
Contadores de Amperios-Horas.
Счетчики Амперъ-Часовъ.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. LTD.
CHAMBERLAIN & HOOKHAM, LTD.
ELECTRICAL APPARATUS CO., LTD
FERRANTI, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

Watt-Hour Meters.
Watts-Heures-Mètres.
Contadores de Vatio-Horas.
Счетчики Ваттъ-Часовъ.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
NALDER BROS. & THOMPSON, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

MINES, Equipments for
Equipement pour **MINES.**
Equipos para **MINAS.**
РУДНИЧНЫЯ Оборудованія.

BERRY, SKINNER & CO
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD
ECKSTEIN, HEAP & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
FRASER & CHALMERS, LTD.
GLOVER, W. T., & CO., LTD.

GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
VICKERS, LTD.
WEST, ALLEN & CO., LTD.

Flameproof Motors.
Moteurs Etanches au Gaz.
Motores Estancos al Gas.
Газонепроницамые Безопасные Моторы.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON, CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD,
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Haulage Gear.
Appareils de Halage.
Aparatos de Tracción.
Транспортныя Устройства.
BRITISH ELECTRIC PLANT CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PARSONS, C. A., & CO., LTD.

Winding Engines.
Machines d'Extraction.
Máquinas de Extracción.
Рудничныя Лебедки.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
FRASER & CHALMERS, LTD.
SIEMENS BROS DYNAMO WORKS, LTD

Mine and Watertight Fittings, see "Fittings for Electric Light."
Accessoires Etanches pour Mines, voir "Accessoire pour Lumière Electrique."
Accesorios Estancos para Minas, véase "Accesorios para Luz Eléctrica."
Рудничныя Водонепроцинаемыя Принадлежности, см. „Принадлежности для Электр. Освѣщ."

Mining Switchgear, see "Switchgear."
Appareils de Distribution pour Mines, voir "Appareils de Distribution."
Aparatos de Distribución para Minas, véase "Aparatos de Distribución."
Рудничныя Распредѣлительныя Устройства, см. „Распр. Устройства".

Mine and Sinking Pumps, see "Pumps."
Pompes d'Exhaure pour Mines, etc., voir "Pompes."
Bombas para Minas, Pozos, etc., véase "Bombas."
Рудничные и Артезіанскіе Насосы, см. „Насосы".

Miners' Safety Lamps, see "Lamps."
Lampes de Sûreté de Mineurs, voir "Lampes."
Lámparas de Seguridad de Mineros, véase "Lámparas."
Рудничныя Пампы, см. „Лампы".

MOTORS for A.C. and D.C.
MOTEURS pour C.C. et C.A.
MOTORES para C.C. y C.A.
МОТОРЫ для Перем. и Пост. Тока.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Crane Motors.
Moteurs de Grues.
Motores de Grúas.
Крановые Моторы.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CROMPTON & CO, LTD
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTROMOTORS, LTD
GENERAL ELECTRIC CO., LTD
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD
REES ROTURBO MANUFACTURING CO., LTD
RHODES MOTORS, LTD
SIEMENS BROS. DYNAMO WORKS LTD.
VICKERS, LTD.

Lift Motors.
Moteurs d'Ascenseurs.
Motores para Ascensores.
Лифтовые Моторы.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD
GREENWOOD & BATLEY, LTD
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD
MAVOR & COULSON, LTD
MAWDSLEY'S LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD
RHODES MOTORS, LTD
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Motor Converters, see "Converters (Motor)."
Transformateurs en Cascade, voir ce mot.
Transformadores en Cascada, véase esta palabra.
Каскадные Конвертеры, см. это слово.

Motor Starters and Panels, see "Control Gear."

Motors, Petrol, see "Prime Movers."
Moteurs à Essence, voir "Machines Motrices."
Motores de Bencina, véase "Máquinas-Motoras."
Бензиновые Двигатели, см. „Двигатели".

Motors, Tramway and Railway, see "Traction."

Moteurs pour Tramways et Chemins de Fer, voir "Traction."

Motores para Tranvias y Ferrocarriles, véase "Tracción."

Трамвайные и Желѣзнодорожные Моторы, см. Подвижные Составы.

NOVELTIES, Advertising and other.

NOUVEAUTES pour Réclames, etc.

NOVEDADES para Reclamos, etc.

НОВОСТИ для Рекламныхъ Цѣлей и др.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD

PENDANTS, see "Fittings."

LAMPES à SUSPENSION, voir "Garnitures."

LAMPARAS de SUSPENSION, véase "Guarniciones."

ПОДВѢСНЫЯ ЛАМПЫ, см. „Гарнитуры".

PHOTOMETERS.

PHOTOMETRES.

FOTOMETROS.

ФОТОМЕТРЫ.

ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD

PRIME MOVERS.

MACHINES MOTRICES.

MAQUINAS-MOTORAS.

ДВИГАТЕЛИ.

Diesel Engines.

Moteurs Diesel.

Motores Diesel.

Двилатели Дизеля.

BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
HICK, HARGREAVES & CO., LTD.
WILLANS & ROBINSON, LTD.

Gas Engines.

Moteurs à Gaz.

Motores de Gas.

Газовые Двигатели.

ALLEN, W. H., SON & CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
RICHARDSONS, WESTGARTH & CO LTD

Petrol and Oil Engines.

Moteurs à Pétrole et à Essence.

Motores de Bencina y de Aceite.

Бензиновые и Нефтяные Двигатели.

ALLEN, W. H., SON & CO., LTD
BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.

Reciprocating Steam Engines.

Machines à Vapeur à Piston.

Máquinas de Vapor de Embolo.

Поршневыя Паровыя Машины.

ALLEN, W. H., SON & CO., LTD.
ASHWORTH & PARKER.
BELLISS & MORCOM, LTD.
BROTHERHOOD, PETER, LTD.
BROWETT, LINDLEY & CO., LTD
BRUSH ELECTRICAL ENGINEERING CO., LTD
CLARKE, CHAPMAN & CO., LTD
FRASER & CHALMERS, LTD.
HOWDEN, JAMES & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.

Steam Turbines.

Turbines à Vapeur.

Turbinas de Vapor.

Паровыя Турбины.

ALLEN, W. H., SON & CO., LTD
BELLISS & MORCOM, LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD PETER, LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
FRASER & CHALMERS, LTD.
GREENWOOD & BATLEY, LTD.
HOWDEN, JAMES & CO., LTD.
PARSONS, C A., & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.

Water Turbines.

Turbines Hydrauliques.

Turbinas Hidráulicas.

Водяныя Турбины.

ASHWORTH & PARKER.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FRASER & CHALMERS, LTD.

PUMPS.

POMPES.

BOMBAS.

НАСОСЫ.

Centrifugal Pumps.

Pompes Centrifuges.

Bombas Centrifugas.

Центробѣжные Насосы.

ALLEN, W. H., SON & CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.

BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

Plunger Pumps.
Pompes à Piston.
Bombas de Embolo.
Плунжерные Насосы.

CLARKE, CHAPMAN & CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO LTD
FRASER & CHALMERS, LTD
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
WORTHINGTON PUMP CO., LTD

Rotary Pumps.
Pompes Rotatives.
Bombas Rotativas.
Ротацiонные Насосы.

ALLEN, W. H., SON & CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
MATHER & PLATT, LTD.
MIRRLEES WATSON CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
WILLANS & ROBINSON, LTD
WORTHINGTON PUMP CO., LTD.

Sinking Pumps.
Pompes d'Exhaure.
Bombas para Minas.
Рудничные Насосы.

BRITISH ELECTRIC PLANT CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
REES ROTURBO MANUFACTURING CO., LTD
WORTHINGTON PUMP CO., LTD.

Turbine Pumps for High Lifts.
Pompes à Turbines Etagées pour H.P.
Bombas de Turbina en Grados para A.P.
Турбо-Насосы для Высокаго Давленiя.

ALLEN, W. H., SON & CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
PARSONS, C. A., & CO., LTD
REES ROTURBO MANUFACTURING CO., LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

PUSHES, see "Accessories."

BOUTONS, voir "Accessoires."
BOTONES, véase "Accesorios."
ЗВОНКОВЫЯ КНОПКИ, см. ,,Принадлежности".

PYROMETERS.

PYROMETRES.
PIROMETROS.
ПИРОМЕТРЫ.

CROMPTON & CO., LTD.
PAUL, ROBERT W.
SIEMENS BROS. & CO., LTD.

RADIATORS, see also "Heating and Cooking."

RADIATEURS, voir aussi "Chauffage et Cuisine."
RADIADORES, véase también "Caldeo y Cocina."
РАДIАТОРЫ, см. также ,,Отопленiе Кухонные Приборы".

BERRY, SKINNER & CO.
BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD
VENNER & CO.

RADIATOR LAMPS, see "Lamps."

LAMPES pour RADIATEURS, voir "Lampes."
LAMPARAS para RADIADORES, véase "Lámparas."
ЛАМПЫ для РАДIАТОРОВЪ, см. Лампы.

REFLECTORS, see "Fittings for Electric Light."

REFLECTEURS, voir "Accessoires pour Lumière Electrique."
REFLECTORES, véase "Accesorios para Luz Eléctrica."
РЕФЛЕКТОРЫ, см. ,,Принадлежности для Электр. Свѣта."

RELAYS, see also "Instruments" and "Control Gear."

RELAIS, voir "Instruments" et "Appareils Contrôleurs."
RELEVADORES, véase "Instrumentos" y "Aparatos de Comprobación."
РЕЛЭ, см. ,,Инструменты" и ,,Контрольные Аппараты".

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD
ECKSTEIN, HEAP & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
NALDER BROS. & THOMPSON, LTD
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. & CO., LTD.
SWITCHGEAR & COWANS, LTD.

RHEOSTATS, see "Control Gear."
RHEOSTATS, voir "Appareils Contrôleurs."
REOSTATOS, véase "Aparatos de Comprobación."
РЕОСТАТЫ, см. ,,Контрольные Аппараты".

ROLLING MILLS, Electrical Equipment of.
Equipement Electrique de **LAMINOIRS.**
Equipos Eléctricos de **LAMINADORES.**
ВАЛЬЦОВКИ, ихъ Электр. Оборудованiе.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC CONTROL, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE & CO., LTD
SIEMENS BROS. DYNAMO WORKS, LTD.

ROTARY CONVERTERS, see "Converters, Rotary."
COMMUTATRICES, voir ce mot.
CONVERTIDORES ROTATORIOS, véase esta palabra.
ВРАЩАЮЩIЕСЯ КОНВЕРТЕРЫ (ПРЕОБРАЗОВАТЕЛИ), см. ,,Конвертеры".

SAFETY LAMPS, see "Lamps."
LAMPES de MINEURS, voir "Lampes."
LAMPARAS de MINEROS, véase "Lámparas."
БЕЗОПАСНЫЯ ЛАМПЫ, см. Лампы.

SEARCHLIGHT PROJECTORS.
PROJECTEURS.
PROYECTORES.
ПРОЖЕКТОРЫ.

BRITISH THOMSON-HOUSTON CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD
PARSONS, C. A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD

SHADES, see "Fittings" and "Glassware."
ABAT-JOUR, voir "Accessoires" et "Verreries."
PANTALLAS, véase "Accesorios" y "Cristalería."
АБАЖУРЫ, см. ,,Принадлежности" и ,,Стеклянная Посуда".

SHIP INSTALLATIONS, Electric.
INSTALLATIONS Electriques pour **NAVIRES.**
INSTALACIONES Eléctricas para **BUQUES.**
СУДОВЫЯ Электрическiя ОБОРУДОВАНIЯ.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T. LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO, LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
ELLIOTT BROTHERS.
GENERAL ELECTRIC CO., LTD
HOWDEN, JAMES & CO., LTD.
IGRANIC ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD
PARSONS, C. A., & CO.
SIEMENS BROS. DYNAMO WORKS, LTD
SUNDERLAND FORGE & ENGINEERING CO., LTD.

Ships' Telegraph.
Télégraphes de Navires.
Telégrafos para Buques.
Судовые Телеграфы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
ELLIOTT BROTHERS.
EVERSHED & VIGNOLES, LTD.
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. & CO. LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.

Shipyard Cranes and Winches.
Grues et Treuils pour Chantiers de Construction Navale.
Grúas y Tornos para Astilleros.
Краны и Лебедки для Верфей.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD
BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD
CROMPTON & CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.

SIGNALLING for RAILWAYS, Electrically operated.
SIGNALISATION Electriques pour **CHEMINS de FER.**
SEÑALES Eléctricos para **FERROCARRILES.**
ЖЕЛѢЗНОДОРОЖНАЯ СИГНАЛИЗАЦIЯ, Электр.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS & CO., LTD

SIGNALS, Fire Alarms, etc.

SIGNAUX, Avertisseurs d'Incendie, etc.

SEÑALES, Alarmas de Incendio, etc.

СИГНАЛЫ, Пожарные и др.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

SIGNS, Electrically Illuminated.

RECLAMES Lumineuses Electriques.

RECLAMOS Luminosos Eléctricos.

ВЫВѢСКИ Электрическіе.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

STARTERS and STARTING PANELS, see "Control Gear."

DEMARREURS et TABLEAUX de DEMARRAGE, voir "Appareils Contrôleurs."

APARATOS y CUADROS de ARRANQUE, véase "Aparatos de Comprobación."

ПУСКОВЫЕ РЕОСТАТЫ и ДОСКИ, см. ,,Контрольные Аппараты".

STEAM ENGINES and STEAM TURBINES, see "Prime Movers."

MACHINES et TURBINES à VAPEUR, voir "Machines Motrices."

MAQUINAS y TURBINAS de VAPOR, véase "Máquinas-Motoras."

ПАРОВЫЯ МАШИНЫ и ТУРБИНЫ, см. ,,Двигатели".

STORAGE, Electrical, see "Accumulators."

ACCUMULAGE d'Electricité, voir "Accumulateurs."

ALMACENAJE de Electricidad, véase "Acumuladores."

АККУМУЛЯЦІЯ Электричества, см. ,,Аккумуляторы".

SWITCHES, see "Accessories" and "Switchgear."

INTERRUPTEURS, voir "Accessoires" et "Appareils de Distribution."

INTERRUPTORES, véase "Accesorios" y "Aparatos de Distribución."

ВЫКЛЮЧАТЕЛИ, см. ,,Принадлежности" и ,,Распредѣлительныя Устройства".

SWITCHGEAR, SWITCHES and SWITCHBOARDS for Mining, Industrial and General Power Purposes.

APPAREILS de DISTRIBUTION, INTERRUPTEURS et TABLEAUX de DISTRIBUTION pour Mines, Usines et Centrales.

APARATOS de DISTRIBUCION, INTERRUPTORES y CUADROS de DISTRIBUCION para Minas, Fábricas y Centrales.

РАСПРЕДѢЛИТЕЛЬНЫЯ УСТРОЙСТВА и ДОСКИ для Рудниковъ, Промышленныхъ и общихъ Цѣлей.

BERRY, SKINNER & CO.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
BROOK, HIRST & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC CONTROL, LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
MORRIS & LISTER, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REES ROTURBO MANUFACTURING CO., LTD
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
VENNER & CO. (Time Switches).
WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

Accumulator Switches (Battery Regulating Switches).

Réducteurs d'Accumulateurs (Réducteurs de Batterie).

Reductores de Acumuladores (Reductores de Bateria).

Аккумуляторные Коммутаторы (Элементные Коммутаторы).

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
NALDER BROS. & THOMPSON, LTD
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
SWITCHGEAR & COWANS, LTD

WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

Circuit Breakers.
Interrupteurs à Levier.
Interruptores de Palanca.
Рычажные Выключатели.

BERRY, SKINNER & CO.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
BROOK, HIRST & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELLISON, GEORGE, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MORRIS & LISTER, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Knife Switches.
Interrupteurs à Couteau.
Interruptores de Cuchillo.
Рубильники.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

TELEGRAPH APPARATUS.
APPAREILS TELEGRAPHIQUES.
APARATOS TELEGRAFICOS.
ТЕЛЕГРАФНЫЕ АППАРАТЫ.

ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS., & CO., LTD.

Telegraphy, Wireless, see "Wireless Telegraphy."
Télégraphie sans Fil, voir "Radio-Télégraphie."
Telegrafía sin Alambres, véase "Radio-Telegrafía."
Безпроволочный Телеграфъ, см. „Радіо-Телегр. Аппараты".

TELEPHONES.
TELEPHONES.
TELEFONOS.
ТЕЛЕФОНЫ.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD

Automatic Telephones.
Téléphones Automatiques.
Teléfonos Automáticos.
Автоматическіе Телефоны.

SIEMENS BROS. & CO., LTD

TELEPHONE SWITCHBOARDS.
TABLEAU COMMUTATEURS pour TELEPHONES.
CUADROS CONMUTADORES para TELEFONOS.
ТЕЛЕФОННЫЕ КОММУТАТОРЫ.

SIEMENS BROS & CO., LTD.

TERMINALS, see "Accessories."
BORNES, voir "Accessoires."
BORNAS, véase "Accesorios."
ЗАЖИМЫ, см. „Принадлежности".

TESTING SETS, see also "Instruments."
APPAREILS de LABORATOIRE, voir aussi "Instruments."
APARATOS de LABORATORIO, véase también "Instrumentos."
ПРИБОРЫ для ИСПЫТАНІЯ, см. также „Инструменты".

BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD
EVERSHED & VIGNOLES, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. & CO., LTD.

TEXTILE MOTORS and EQUIPMENT.

MOTEURS et ACCESSOIRES pour l'INDUSTRIE TEXTILE.

MOTORES y ACCESORIOS para la INDUSTRIA TEXTIL.

МОТОРЫ и ОБОРУДОВАНІЯ въ ТЕКСТИЛЬНОЙ ПРОМЫШЛЕННОСТИ.

BOOTHROYD, H. T., LTD
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES BRUCE & CO, LTD.
REES ROTURBO MANUFACTURING CO., LTD
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
WILSON-WOLF ENGINEERING CO., LTD.

THEATRE LIGHTING.

ECLAIRAGE de THEATRES.

ALUMBRADO de TEATROS.

ОСВѢЩЕНІЕ ТЕАТРОВЪ.

BRITISH THOMSON-HOUSTON CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROTHERS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

TRACTION APPLIANCES.

MATERIEL de TRACTION.

MATERIAL de TRACCION.

ПОДВИЖНЫЕ СОСТАВЫ.

Bonds.

Eclisses.

Juntas.

Стыки.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
GLOVER, W. T., & CO., LTD.

Brakes.

Freins.

Frenos.

Тормаза.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.

Car Bodies.

Carrosserie.

Carroceria.

Вагонные Кузовы.

BRUSH ELECTRICAL ENGINEERING CO., LTD.

Gears.

Engrenages.

Engranajes.

Приводы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD

Locomotives.

Locomotives.

Locomotoras.

Локомотивы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
DICK, KERR & CO., LTD.

Motors.

Moteurs.

Motores.

Моторы.

BOOTHROYD, H T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD
PEEBLES, BRUCE, & CO., LTD
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Controllers, see "Control Gear."

Contrôleurs, voir "Appareils Contrôleurs."

Controleres, véase "Aparatos de Comprobación."

Контролеры, см. „Контрольные Аппараты."

Line Insulators, see "Insulators."

Isolateurs pour Lignes Aériennes, voir "Isolateurs."

Aisladores para Lineas Aéreas, véase "Aisladores."

Изоляторы для Трамвайныхъ Воздушныхъ Проводовъ, см. „Изоляторы".

Overhead Lines, see "Transmission."

Lignes Aériennes, voir "Transport d'Energie."

Lineas Aéreas, véase "Transmisión de Energía."

Воздушныя Проводки, см. „Передача Силы".

TRANSFORMERS for Power and Lighting.

TRANSFORMATEURS pour Force Motrice et Eclairage.

TRANSFORMADORES para Fuerza Motriz y Alumbrado

ТРАНСФОРМАТОРЫ для Силы и Освѣщенія.

BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FERRANTI, LTD
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Transformers for Instruments, see "Instruments."

Transformateurs pour Instruments, voir "Instruments."

Transformadores para Instrumentos, véase "Instrumentos."

Трансформаторы для Инструментовъ см. ,,Инструменты''.

TRANSMISSION LINES.

LIGNES pour le TRANSPORT d'ENERGIE.

LINEAS para la TRANSMISION de ENERGIA.

ЛИНІИ для ПЕРЕДАЧИ СИЛЫ.

Poles.

Poteaux.

Postes.

Столбы.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD
SIEMENS BROS. & CO., LTD.

Overhead Lines, Aluminium.

Lignes Aériennes en Aluminium.

Lineas Aéreas de Aluminio.

Алюминіевыя Воздушныя Линіи.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.

Overhead Lines, Copper.

Lignes Aériennes en Cuivre.

Lineas Aéreas de Cobre.

Мѣдныя Воздушныя Линіи.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. & CO., LTD.

Insulators for Transmission Lines, see "Insulators."

Isolateurs pour Lignes de Transport d'Energie, voir "Isolateurs."

Aisladores para Lineas de Transporte de Energia. véase "Aisladores."

Изоляторы для Воздушныхъ Линій, см. ,,Изоляторы''.

TUBING, see "Conduit."

TUBES, voir "Tubes Isolants."

TUBOS, véase "Tubos Aisladores."

ТРУБКИ, см. ,,Изоляціонныя Трубки''

TURBINES, Steam and Water, see "Prime Movers."

TURBINES à Vapeur et Hydrauliques, voir "Machine Motrices."

TURBINAS de Vapor y Hidráulicas, véase "Máquinas-Motoras."

ТУРБИНЫ, Паровыя и Водяныя, см. ,,Двигатели''.

VENTILATING FANS, see "Fans."

VENTILATEURS EXTRACTEURS, voir "Ventilateurs."

VENTILADORES EXTRACTORES, véase "Ventiladores."

ВЫТЯЖНЫЕ ВЕНТИЛЯТОРЫ, см. ,,Вентиляторы''.

WATER COOLING TOWERS.

TOURS REFRIGERANTES A EAU.

TORRES REFRIGERANTES POR AGUA.

ГРАДИРНИ.

PREMIER COOLER & ENGINEERING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WORTHINGTON PUMP CO., LTD.

WELDING, Electric, Appliances.

Appareils de **SOUDURE** Electrique.

Aparatos de **SOLDADURA** Eléctrica.

Аппараты для Электр. **СВАРКИ.**

CROMPTON & CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

WINCHES, see "Arc Lamps" and "Ship Installations."

TREUILS de LEVAGE, voir "Lampes à Arc" et "Installations pour Navires."

TORNOS de ELEVACION, véase "Lámparas de Arco" y "Instalaciones para Buques."

ЛЕБЕДКИ, см. ,,Дуговыя Лампы'' и ,,Судовыя Оборудованія''.

WIRELESS TELEGRAPHY APPLIANCES.

APPAREILS RADIO-TELEGRAPHIQUES.

APARATOS RADIO-TELEGRAFICOS.

РАДІО-ТЕЛЕГРАФНЫЕ АППАРАТЫ.

LANCASHIRE DYNAMO & MOTOR CO., LTD.
SIEMENS BROS. & CO., LTD.

WIRES, see also "Cables."

FILS, voir aussi "Cables."

ALAMBRES, véase también "Cables."

ПРОВОДА, см. также ,,Кабели''

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

INDEX FRANÇAIS.

avec la traduction en anglais des en-tête sous lesquels est arrangé alphabétiquement l'Index Général en quatre langues, voir pages i. D—xxi. D.

Index Francais.

ÍNDICE ESPAÑOL

con la traducción en inglés de los títulos, bajo les cuales se ha arreglado alfabéticamente el Indice General en cuatro idiomas, véase páginas i D—xxi. D.

Índice Español.

РУССКІЙ УКАЗАТЕЛЬ

съ переводомъ на англійскій языкъ, по алфавиту котораго составленъ Общій Указатель на четырехъ языкахъ, см. стран. i. D—xxi. D.

INDEX TO COMPANIES IN CLASSIFIED DIRECTORY

NAME.	Head Offices or Works.	Telegraphic Address	Codes Used
ALLEN, W. H., SON & CO., LTD. ..	Queen's Engineering Works, Bedford.............	Pump, Bedford	A.B.C. 5th Edition, A1 Engineering, Broomhall Imperial Atom, Western Union and Private.
ALLEY & MACLELLAN, LTD.......	Sentinel Works, Polmadie, Glasgow	Alley, Glasgow........	A.B.C. 5th Edition, Engineering Telegraph, Western Union.
*ARON ELECTRICITY METER, LTD.	80A, Salusbury Road, Kilburn, London, N W.	Arronzar, London.....	A B.C 4th and 5th Editions
ASHWORTH & PARKER............	Bury, Lancs....................................	Kinetic	Western Union, A.B C. 5th Edition
*BELLISS & MORCOM, LTD.........	Ledsam Street Works, Birmingham..............	Belliss, Birmingham....	A.B.C. 5th Edition, Engineering 2nd Edition, Western Union (Universal Edition), Lieber's.
*BERRY, SKINNER & CO.............	78, Upper Thames Street, London, E.C...........	Ptolemaist	A B.C Code 4th and 5th Editions
" " "	Suffolk Works, Ozells Street, Birmingham........	"	Western Union, Universal Edition
*BOOTHROYD H. T., LTD	Bootle, Liverpool..............................	Commutator, Liverpool.	———————
BRAY, MARKHAM & REISS, LTD...	Blackhorse Lane, Walthamstow, N.E..............	Bramaria, Walthill, London	———————
*BRITISH ELECTRIC PLANT CO., LTD.	78 St. Vincent Street, Glasgow	Bepco, Glasgow.......	A.B.C. 5th Edition.
*BRITISH ELECTRIC TRANSFORMER CO., LTD	Hayes, Middlesex, and 48, Oxford Street, London, W................	Transfundo, Hayes, Middlesex	A.B.C. 5th Edition, Western Union Engineering, 2nd Edition.
*BRITISH THOMSON-HOUSTON CO., LTD.	Rugby, England................................	Asteroidal Rugby; Solutrix, London	Lieber, A.B.C. and Western Union
" " " "	Mazda House, 77, Upper Thames Street, E.C.......	Mazdalux, Cannon, London	Lieber's, A B C.
*BRITISH WESTINGHOUSE ELECTRIC & M'F'G. CO., LTD.	Trafford Park, Manchester......................	Westinghouse, Manchester	A.B.C. 5th Edition, Western Union Lieber's.
*BROOK, HIRST & CO., LTD........	Northgate Electrical Works, Chester............	Switches, Chester......	A.B.C. 5th Edition.
BROTHERHOOD, PETER, LTD......	Peterborough	Brotherhood, Peterborough. Brotherhood, Parl, London..	A.B.C. 5th Edition.
*BROWETT, LINDLEY & CO., LTD...	Patricroft, Manchester.........................	Sandon, Patricroft.....	Lieber's, A.B.C. 5th Edition, Engineering.
*BRUSH ELECTRICAL ENGINEERING CO., LTD.....................	Falcon Works, Loughborough, Leicestershire......	Falcon, Loughborough.	A.B C. 5th Edition, A1, Western Union, Engineering.
" " " "	LONDON OFFICE:—1, Kingsway, London, W.C	Magneto, London.	" " "
*CALLENDER'S CABLE & CONSTRUCTION CO., LTD.	Hamilton House, Victoria Embankment, London, E.C.	Callender, Fleet, London	———————
CHAMBERLAIN & HOOKHAM, LTD.	Solar Works, Birmingham........................	Solar, Birmingham....	ABC. 5th Edition, Western Union
*CLARKE, CHAPMAN & CO., LTD...	Gateshead-on-Tyne	Cyclops, Gateshead ..	A.B.C. 4th and 5th Editions, A1, Engineering 1st and 2nd Editions, Lieber's, Broomhall's, Moreing and Neil's, Watkins, Western Union and Private.
CREDENDA CONDUITS CO., LTD.	Chester Street, Aston, Birmingham	Credenda, Birmingham	———————
*CROMPTON & CO., LTD..........	Salisbury House, London Wall, E C.............	Crompton, Ave, London	Bentley, A.B.C. 5th Edition, Lieber's
DAY, ST. JOHN, (PATENTS), LTD...	Bank Mills, Morton Street, Oldham	Day, 305 Oldham	A.B.C. 5th Edition.
*DICK, KERR & CO., LTD..........	Abchurch Yard, Cannon Street, E.C..............	Dicker, London.......	Bentley, Western Union, Lieber's, A.B.C. 5th Edition
D.P. BATTERY CO., LTD..........	Lumford Mills, Bakewell, Derbyshire, and 11, Victoria St., Westminster, S W.........................	Battery, Bakewell; Cumulose, London..	A.B.C. 5th Edition, New Business, Private.
*ECKSTEIN, HEAP & CO., LTD......	Lancashire Switchgear Works, Broughton, Manchester	Electron..............	———————
ELECTRICAL APPARATUS CO., LTD.	Vauxhall Works, South Lambeth Road, London, S.W.	Elapratus, London.....	A.B.C. 5th Edition
*ELECTRICAL ENGINEERING AND EQUIPMENT CO., LTD............	Bank Buildings, 109-11, New Oxford Street London, W.C..	Thermotype, Westcent, London	A.B.C. 5th Edition.
*ELECTRIC CONTROL LTD.	177, Reid Street, Glasgow, and	Control, Glasgow	———————
	Queen Anne's Chambers, Westminster, S.W........	Autoswitch, Vic. London	A.B.C. 5th Edition.
*ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.................	Cheston Road, Aston, Birmingham	E.O.A. Birmingham....	A B.C. 5th Edition.
*ELECTROMOTORS, LTD............	Openshaw, Manchester..........................	Magnet, Manchester...	A B.C. 5th Edition.
*ELLIOTT BROTHERS..............	1, Central Buildings, Westminster, S.W...........	Elliottize, London.....	A B.C. 5th Edition.
ELLISON, GEORGE	Victoria Works, Warstone Lane, Birmingham.......	Induction, Birmingham	Western Union, Lieber's and Engineering.
*EVERETT, EDGCUMBE & CO., LTD.	117, Victoria Street, S W.......................	Everectus	A.B.C. 5th Edition
" " " " ...	FACTORY:—Collindale Works, Hendon, N.W.	———————	———————
*EVERSHED & VIGNOLES, LTD.....	Acton Lane Works, Chiswick, London, W...........	Dorothea, London.....	A.B.C. 5th Edition, Western Union (Universal Edition), Eng. 2nd Ed

NAME.	Head Offices or Works.	Telegraphic Address.	Codes Used.
*FERRANTI, LTD.	Central House, Kingsway, London, W.C.	Ferranti, Westcent, London; Cables—Ferranti, London.	A.B.C. 4th and 5th Editions. A1. Cole. Engineering. Lieber's. Western Union.
" "	WORKS:—Hollinwood, near Manchester	——	" " "
*FRASER & CHALMERS, LTD.	Erith, Kent	Vanner, Erith	A.B.C. 4th and 5th Editions, Moreing and Neal, Broomhalls, Imperial, Western Union.
GENERAL ELECTRIC CO., LTD.	67, Queen Victoria Street, London, E.C.	Electricity Cables, Polyphase	A.B.C. Lieber's, Western Union.
GLOVER, W. T., & CO., LTD.	Trafford Park, Manchester	Cables, Manchester	A.B.C. 5th Edition, Lieber's, Western Union and Private Code.
*GREENWOOD & BATLEY, LTD.	Albion Works, Armley Road, Leeds	Greenwood, Leeds	A.B.C. 4th and 5th Editions, Lieber's Engineering 1st and 2nd Editions, A1 Western Union and Bentley's.
*HENLEY'S, W. T., TELEGRAPH WORKS, LTD.	Blomfield Street London, E.C.	Inland, Henletel Ave, London; Cables—Henleys, London.	Western Union. A.B.C., 5th Edition Lieber's and Private.
HICK, HARGREAVES & CO., LTD.	Soho Iron Works, Bolton	Hick, Bolton	A.B.C. 5th Edition. A1 (1888). Western Union (Universal Edition). Lieber's Standard.
*HOWDEN, JAMES & CO., LTD.	195, Scotland Street, Glasgow	Howden, Glasgow	A.B.C. 5th Edition, Western Union.
*IGRANIC ELECTRIC CO., LTD.	147, Queen Victoria Street, London, E.C.	Igranic	Lieber's and Private.
" "	WORK:—Bedford, England	——	——
*JANDUS ARC LAMP & ELECTRIC CO., LTD.	Hartham Road, Holloway, London, N.	Jandunus, Holway, London	A.B.C. 5th Edition.
JOHNSON & PHILLIPS, LTD.	Victoria Works, Charlton, London, S.E.	Juno Charlton, Kent.	A.B.C., 5th Edition, A1, 5th Edition Engineering, Lieber's, Western Union.
LANCASHIRE DYNAMO & MOTOR CO., LTD.	Trafford Park, Manchester	Ironclad, Manchester	A.B.C. 5th Edition, Western Union, Engineering, Cole's
LIVERPOOL ELECTRIC CABLE CO., LTD.	Linacre Lane, Bootle, Liverpool	Concentric, Liverpool	A.B.C. 5th Edition.
LUCY & CO., W., LTD.	Eagle Ironworks, Oxford	Lucy, Oxford	——
*LUNDBERG, A. P., & SONS	477-489, Liverpool Road, London, N	Lundberg, London	A.B.C. 5th Edition.
MATHER & PLATT, LTD.	Park Works, Newton Heath, Manchester	Mather or Sprinkler, Manchester	Western Union, Universal Edition. Lieber's, A.B.C. 4th and 5th Editions, A1, M. & P. Private.
MAVOR & COULSON, LTD.	47, Broad Street, Mile End, Glasgow	Prodigious, Glasgow	A.B.C. 5th Edition, Engineering 2nd Edition, Bentley's.
MAWDSLEY'S, LTD.	Zone Works, Dursley, Glos.	Zone, Dursley	A.B.C. 5th Edition.
MIRRLEES WATSON CO., LTD.	45, Scotland Street, Glasgow, and 122, Cannon Street London, E.C.	Mirrlees, Glasgow; Mirrlees, Cannon, London	Western Union, Lieber's, Engineering, A.B.C. and A1.
*MORGAN CRUCIBLE CO., LTD.	Battersea Works, London, S.W.	Crucible, Battsquare, London (two words chargeable)	A.B.C. 4th and 5th Editions A1. Lieber's and Western Union (Universal Edition).
MORRIS & LISTER, LTD.	Carlton Works, Lockhurst Lane, Coventry	Carlton, Coventry	——
NALDER BROS. & THOMPSON, LTD.	97a, Dalston Lane, London, N.E.	Occlude, Kinland, London	Western Union.
*OSRAM-ROBERTSON LAMP WORKS LTD.	Brook Green, Hammersmith, London, W.	Electricity London. Cables—Polyphase	A.B.C., Lieber's, Western Union and Private.
*PARK ROYAL ENGINEERING WORKS, LTD.	Cumberland Avenue, Willesden, London, N.W.	Isobar, Harles, London.	A.B.C. 5th Edition.
*PARSONS, C. A., & CO., LTD.	Heaton Works, Newcastle-on-Tyne	Turbo, Newcastle-on-Tyne	A1, A.B.C., Western Union.
" "	LONDON OFFICE:—8, Victoria Street, London, S.W.	Silently Vic, London	" " "
*PAUL, ROBERT W.	Newton Avenue Works, New Southgate, N., and 1, East 42nd Street, New York, U.S.A.	Unipivot, London	——
*PEEBLES, BRUCE, & CO., LTD.	Edinburgh	Peebles, Edinburgh	Western Union, A.B.C., 5th Edition New Business and Private.
*PHŒNIX DYNAMO M'F'G. CO., LTD.	Thornbury Works, Bradford	Dynamo, Bradford	A.B.C. 5th Edition and Private.
PIRELLI, LTD.	144, Queen Victoria Street, London, E.C.	Pirellicon Cent, London	——
*PREMIER COOLER & ENGINEERING CO., LTD.	Broadway Court, Broadway, Westminster, S.W.	Precooler, Vic, London	Lieber's, A.B.C. 5th Edition
PRITCHETTS & GOLD & ELECTRICAL POWER STORAGE CO., LTD.	82, Victoria Street, London, S.W.	Acidulated, Sowest, London	Bentley's or A.B.C. 5th Edition

NAME.	Head Offices and Works.	Telegraphic Address.	Codes Used.
REASON MANUFACTURING CO., LTD.	Lewes Road, Brighton	Reason, Brighton	A.B C. 5th Edition.
*RECORD ELECTRICAL CO., LTD.	Caxton House, Westminster	Infusion, London	A.B.C. 5th Edition and Bentley's.
" " "	WORKS :—Broadheath, Manchester	———	———
*REES ROTURBO MANUFACTURING CO., LTD.	Wolverhampton	Roturbo, Wolverhampton	Engineering 2nd Edition, A1 Western Union, A.B.C. 5th Edition.
REYROLLE, A. & CO., LTD.	Hebburn-on-Tyne, England	Reyrolle, Hebburn	A.B.C 5th Edition, Western Union (Universal Edition) and New Business
*RHODES MOTORS, LTD.	Riverside Works, Doncaster	Rhodique, Doncaster	A.B.C. 5th Edition and Private, Hamilton's Code Condenser.
*RICHARDSONS, WESTGARTH & CO. LTD.	Hartlepool	Richardsons, Hartlepool	A.B.C. 5th Edition, Western Union.
SANDYCROFT LTD.	Sandycroft, near Chester	Sandycroft, Hawarden	———
SIEMENS BROS. & CO., LTD.	Telegraph Works, Woolwich	Siemens Woolwich	A.B.C. 5th Edition, Lieber's, Western Union, Broomhall, Moreing and McCutcheon
*SIEMENS BROS. DYNAMO WORKS, LTD.	Caxton House, Westminster, S W.	Siembralos, Vic. London	Moreing and McCutcheon, Lieber's, Western Union, A.B.C. 4th and 5th Editions, A1 Engineering.
" " " " "	38 & 39, Upper Thames Street, E.C.	Siemotor, Cent. London	" "
*SUN ELECTRICAL CO., LTD.	118-120, Charing Cross Road, London, W.C.	Secablis Ox, London	A.B.C. 5th Edition.
*SUNDERLAND FORGE & ENGINEERING CO., LTD	Sunderland	Marr	———
*SWITCHGEAR & COWANS, LTD.	Springfield Lane, Salford, Manchester	Control, Manchester	Western Union, A.B.C. 4th Edition
TUDOR ACCUMULATOR CO. LTD.	3, Central Buildings, Westminster, London S.W.	Extudorex, London	A.B.C 5th Edition.
VENNER & CO.	6, Old Queen Street, Westminster, London, S.W.	Trydan Vic, London	A.B.C. 5th Edition, Western Union. Marconi, Private.
*VICKERS, LTD	Sheffield and London, Westminster, S.W.	Vickers, Sheffield	A.B.C. 5th Edition, Western Union
WEST, ALLEN & CO., LTD.	Lewes Road, Brighton	Control, Brighton	5th Edition, A.B.C.
WESTMINSTER ENGINEERING CO., LTD.	Victoria Road, Willesden Junction, N.W.	Regency, London	A.B.C. 5th Edition.
WHIPP & BOURNE	Castleton, Manchester	Switches, Castleton, Lancs.	A B C. and Lieber's.
*WILLANS & ROBINSON, LTD.	Victoria Works, Rugby	Willans, Rugby	A1, Lieber's, Cole, A.B.C. 4th and 5th Eds., Eng. 2nd Ed.
*WILSON-WOLF ENGINEERING CO., LTD.	Bradford	Energy	A.B.C., 5th Edition, and Private.
*WORTHINGTON PUMP COMPANY LTD.	India House, Kingsway, W.C.	Pumping, Estrand, London	———

* See announcement in advertisement pages, which are arranged alphabetically.
* Voir les pages des annonces placées par ordre alphabétique.
* Véanse las páginas continiendo los anuncios en órden alfabético.
* Si vedano le pagine degli annunzi posti per ordine alfabetico.
* См. въ объявленіяхъ, расположенныхъ по алфавиту.

THE MERIT OF VALUE.

It is said that re-adjustment of values will be one of the results of the War. Many persons do need to change their standard of value. But intelligent persons have always the same criterion ; their standard of value is quality. They prefer good materials, good workmanship, good brains and good men. A good price is another matter !

But some people don't haggle over prices if they can get the goods that merit their price. They know that satisfaction follows a wise choice.

This war is being fought to preserve a certain quality of Intelligence in men. Its result will not be to land us into a price-cutting contest. Rather it should emphasize the worth of all intelligent effort to improve conditions.

British Manufacturers will not, we hope, repudiate the value of a reputation for quality in British goods.

They produce the best they can at the lowest price consistent with Quality.

They know that in the competition for efficiency and reliability their products never lose.

The B.E.A.M.A. can therefore recommend the manufactures of its members to all who wish to buy the best in Electrical and Steam Machinery and Accessories.

Consult the DIRECTORY OF MANUFACTURES in this Journal and write direct to the firms, whose addresses will be found in the Index. Mention *The Beama Journal* and your enquiry will receive prompt attention.

THE BEAMA JOURNAL

PROTECTION FOR NATIONAL PROGRESS.

What is a National Policy? A National Policy is never framed except by a strong, co-herent nation, one that has become self-conscious of its national aims and ideals.

A Nation's ideals are formulated slowly by the people and are accepted often merely tacitly until a crisis arise to threaten them, either from within or without. Then the Nation may make its ideals articulate and declare that it will find means to protect its cherished traditions and to preserve its peculiar individuality. A nation will rise in this way as one man when danger threatens, just as an individual or a class will seek to protect himself or itself against unjust aggression from others.

Individuality is strengthened by such encounters. But no one who has reached any degree of intelligence will go out of his way to provoke a trial of strength. The natural laws of evolution will provide these tests. Bullies and professional fighters are of a low grade of intelligence; fanatics and unbalanced "reformers" view the world from a narrow angle of vision.

Amongst modern nations, Germany has proved to be the bully, the professional fighter and fanatic *par excellence*. Great Britain with her larger understanding of individual freedom as an essential for progress, has been content, as a nation, to let her ideals take care of themselves, not suspecting the danger to them from a determined fanatic among the nations. The fighter-nation has now come out into the open and we know its method. But time and energy will be wasted if we spend them devising means of retaliation. No nation can teach another, none can learn for another; each learns only by experience. Therefore, methods of revenge will not promote our own national security; they will but perpetuate antagonism.

Our ethical and moral standards are such that reprisals, merely as vindictiveness, cannot be used by any self-respecting man to-day. Neither can a nation such as ours stoop to methods of retaliation. We must not be anti-German; *we must be Pro-British!*

THE MOTIVE FOR PROTECTION.

Our motive should be to develop our nation and the British Empire. It must not be to crush any other nation, not even Germany. Each nation may be left to reap what it has sown, and Germany will suffer the consequences of her ridiculous desire to dominate the world and to impose her standards on others. And we should suffer also if we violated the law that universally operates to give individuals the right to develop.

This war is being fought to preserve this principle,—to prevent one nation from dominating others by efforts for "supremacy." It is very loose thinking, therefore, to advocate, as many do, "a war for *commercial supremacy*" to follow the cessation of military hostilities. This would be only to fall into the same sin as Germany, and ultimately to become corrupted by greed and lust of power.

We maintain our navy as a means of *defence*, not for aggression; it *protects* commerce. But further protective measures are necessary if our commerce is not to be taken from us slowly and insidiously, along with standards of commercial conduct and of high-class products. The navy would then have nothing to protect and would soon perish for lack of maintenance.

Universal Free Trade is undoubtedly the ideal for the world, and it must be kept in view even while nations adopt methods of protection and security which are necessary among unequally civilized races. Each nation finds free trade within its different divisions beneficial. The rapid growth of the German Empire was assisted by the abrogation of tariffs between her various states. In the United States tariffs between them would make business very difficult and hamper industry. But in Germany and the United States, as also in other countries, there is no antagonism in thought between the internal states and provinces to seek expression in obstructive tariffs; they are consolidated amongst themselves in national sentiment.

The nations of the world, however, do not yet feel this security against aggression from each other, and until they do they will not recognize the advantage of free international trading and be willing to adopt it as a national policy. It is indeed probable that they will enter upon a period of high commercial tariffs almost in competition as to who can raise the highest wall. They would arrive at a point then when they would begin to bargain with one another to lower these barriers and perhaps *in time* the nations would learn how necessary they are to each other; how they stand or fall together; and how Humanity really requires mutual exchange and mutual toleration amongst its members if it is to advance to its high destiny.

In the meantime Great Britain would be in a stronger position to negotiate with other nations for reciprocal reductions if she could protect herself against unjust aggression, not only by her navy and army, but also by a tariff.

An army and navy are necessary at present to preserve and strengthen national interests. As the army and navy are supported by commerce a tariff is equally necessary in order to protect commerce, to preserve the navy and to strengthen the nation.

This is the true justification of protective tariffs which aim to *protect* national industries and to assist in maintaining a commercial balance amongst the nations, so that each will have an equal chance and none will crush others.

Every nation has a right to live, if it respect the same right for others. But the object and motive of Germany's high protective tariffs were far other than this. These walls were erected to build up the German Empire *in order to use its power for conquest.* Nevertheless the same weapon may be used with fundamentally different motives, even as our purpose in military execution is diametrically opposite to Germany's original aim.

NOT A PARTY POLICY.

The question of protection therefore should be considered impartially from all sides, by all parties, as a *National Policy* indicated by the highest interests of the whole human race, and *not as a party policy.* Many party politicians advance their special fiscal theory as a cure-all for social injustices. They argue from facts observed during a limited number of years. But statistics are unreliable; they may be used to prove any theory. The war has made evident how infinitely complex are the economic factors, and how vain to attempt to deduce conclusions by any academic or partisan methods. Most of the arguments used hitherto by Free Traders and Tariff Reformers must be scrapped. We must look deeply into the meaning of nationality and try to formulate its function in human evolution. We must rest our purpose on bed-rock, on the indisputable Principles which govern human progress. We must define our position in terms of Great Britain's highest conceptions of right. We must protect our ideals against destruction by inferior standards of life. We must conserve and develop the capacities of all classes in the community with the end in view of a balanced, harmonious nation seeking to promote the interests of her people and of the whole race.

A protective tariff would be a means to this end, though we should have to be prepared for many necessary re-adjustments under it.

THE COST.

We cannot have a tariff without paying for it, just as we cannot have a navy without providing the money. But everything worth while is gained only by sacrificing something else. "The same inexorable price" must be paid for every advantage. The expense of the navy is met by the people of the country, and they also have to bear the greater part of the burden of a tariff. It is evidently fair then that the people should decide whether the national strength, which properly constructed tariffs develop, is worth paying for. History has shown that the people usually are willing to pay for the right ideal. A statesman need never fear to declare openly his plans if his policy be based on principles; if the motive be national security, and not the promotion of class interests. The appeal to the imagination in the former is always sure of success.

If a tariff be framed so that the cost does not fall unfairly on certain classes, and certain others do not reap the benefit, a national party might be created such as Sir Arthur Markham proposed in a letter to *The Morning Post*, December 3rd, 1915. The main points in this letter are in the following paragraphs:—

"Permit me to say I entirely share your views that the old political divisions should be buried in

oblivion, and that despite party politicians and wire-pullers we should form a National Party in this country. The crimes committed by the German Government are, to my mind, entirely outweighed by the fact that the German people have associated themselves with every such crime. . . . .

Free Trade, a doctrine which presupposes international amity and honour, falls to the ground when confronted with the situation created by a nation of criminals. . . . .

Let every man and woman in this country pause and realize the meaning of the fame won by the Australians, Canadians and New Zealanders, and other contingents from the Dominions and Dependencies on the battlefields of Europe. Let them ponder what wonderful faith could inspire men, many of whom have never previously seen the land of their forefathers, to be willing to give up their lives in the attempt to uphold the British Empire and all that it stands for as regards the liberty of the human race.

This great upheaval, with all the terrible sorrow and suffering it has entailed, at least gives us an opportunity of making a fresh start and of working out a National Policy which will express the new spirit born of the war. Officers and men have learnt in the trenches a new spirit of mutual respect, self-sacrifice and affection, which, if properly directed and not exploited by party politicians, should result in a changed social conscience at home. One would despair of human nature if after such suffering all classes do not join together to secure better conditions of labour and a better distribution of wealth as between rich and poor. The true National Policy we ought to evolve is rooted in true ideals of social reform as well as of Imperial Unity. In my opinion such a National Policy should be directed to the following end:

(1) Closer Imperial Union between the Mother Country and the Dominions.

(2) A Zollverein between the British Empire and the Allies.

(3) A vigorous policy of social reform which aims at a *better and finer England* as the only worthy memorial to the dead."

A National Party on these lines could come into being only by including a policy of social reform as Sir Arthur Markham suggests. But it will not remain long in existence if the promises are not fulfilled, or if the benefits from a tariff are not fairly distributed for the good of the nation as a whole. Again, the strong sense of personal liberty and individual freedom in British people will not welcome any measures of State Socialism nor paternal state-aid schemes, no matter how well meaning. (Their effectiveness is another question). The significance of a National Policy is that the interest of all classes is enlisted for the policy, whatever it may be. Leaders know that the success of any programme is contingent upon this support. To secure it they appeal to various motives, and, the kind of motive, the particular quality of human emotion, that is affected, characterizes the result. Scientific knowledge and skilful organization may be allied to motives which will destroy a civilization after it has been constructed. For it is not by knowledge that progress is made, but by *the right use of knowledge*, and this depends on the motive which prompts the people to act.

National efficiency is, of course, rooted in individual efficiency, and the British regard for the individual is the best soil on which a nation or empire can grow. Schemes which would minimize the individual and make him subsidiary to a "state" have a canker at the core which will produce a rotten kingdom in time. For the play of Intelligence through individuals cannot be ignored. Individual men construct and constitute each nation. Man was not made for the state; but states *are* made for man, by man. A nation is a field, an opportunity for the development and expansion of individuals in co-operation and competition with each other. A state or nation *per se* cannot generate enlightenment. No policy, no science, no philosophy, no new law or religion, has ever been enunciated by a "state" *as such*. The varying forms of Government which come and go are merely expressions of the manner in which men choose that they or the state shall be protected in their rights, each from the other, as well as from other states and peoples. But an individual man is always the medium of Intelligence and, the larger the number of enlightened men, the better the civilization.

Therefore, permanent, progressive improvement is ensured only by enlarging opportunities for individual development on the basis of individual assent.

If a National Policy be rooted in this Principle the nation will be secure, because the springs of progress are not dammed at their source, but are left free to flow, to water the land and to nourish the Policy. If imagination be limited by some exclusive state-scheme, as in Germany, invention, philosophy, art and literature decay and no great men arise to stimulate thought; official state-ambitions dominate and limit development. This dearth of ideas has been observed in Germany for more than forty years. The inference is that national consolidation alone will not secure the future; it may mean, indeed, but the death of a civiliza-

tion. The motive for consolidation, therefore, is the basic consideration.

Fundamentally, then, the purpose of protective tariffs in this country should be to make Great Britain strong, *because her principles and policies provide for the growth of strong individuals;* and her strength will endure only so long as this is so. If the higher motives, those consistent with the laws of evolution, are to be invoked amongst all classes, then those classes must be consulted.

Therefore, a constructive plan, the execution of which requires the co-operation of all classes in the community, is necessary. This could be initiated by a Co-operative Conference between, the Associations representative of the several industries; the various Employers' Associations; the Labour Unions; the Agricultural Organizations, and Educational and Scientific Bodies.

LIFE AND DOCTRINE.* By President WOODROW WILSON.

The world has advanced, advanced in what we regard as real civilization, not by material, but by spiritual means and one nation is distinguished from another nation by its ideals, not by its possessions; by what it believes in, by what it lives by; by what it intends; by the visions which its young men dream and the achievements which its men of maturity attempt. So that each nation exalts, when it writes its poetry or writes its memoirs, the character of its people and of those who spring from the loins of its people.

There is no real antithesis between life and doctrine. A man lives as he believes he ought to live or as he believes that it is to his advantage to live. He lives upon a doctrine, upon a principle, upon an idea—sometimes a very low principle, sometimes a very exalted principle. . . .

An egotist is a man who has got the whole perspective of life wrong. He conceives himself as the centre of affairs. He has not related himself to the great forces which dominate him with the rest of us, and therefore has set up a little kingdom all his own in which he reigns with unhonoured sovereignty. So there are some men who set up the principles of individual advantage as the principle, the doctrine, of their life, and live by that and live generally a life that leads to all sorts of shipwreck. Whatever our doctrine be, our life is conformed to it.

*   *   *

Co-operation is the vital principle of social life. Not organization merely. I think I know something about organization. I can make an organization, but it is one thing to have an organization and another thing to fill it with life. And then it is a very important matter what sort of life you fill it with. If the object of the organization is what the object of some business organizations is and the object of many political organizations is, to absorb the life of the community and run the community for its own benefit, then there is nothing profitable in it.

But if the object of the organization is to afford a mechanism by which the whole community can co-operatively use its life, then there is a great deal in it. An organization without the spirit of co-operation is dead and may be dangerous. So that the vital principle is co-operation, and organization is secondary.

*   *   *

Legislation cannot save society. Legislation cannot even rectify society. The law that will work is merely the summing up in legislative form of the moral judgment that the community has already reached. Law records how far society has got, and there have got to be instrumentalities preceding the law that gets society up to that point where it will be ready to record. Try the experiment. Enact a law that is the moral judgment of a very small minority of the community, and it will not work. Most people will not understand it, and, if they do understand, they will resent it, and, whether they understand it and resent it or not, they will not obey it. Law is a record of achievement. It is not a process of regeneration. Our wills have to be regenerated and our purposes rectified before we are in a position to enact laws that record those moral achievements.

* From a speech delivered at Columbus, Ohio, Dec. 10th, 1915.

THE EQUILIBRIUM OF SOCIETY.

In the abundance of literature on Sociology, in the prolific pamphleteering on war-economics, one may find enumerated many causes for our social mal-adjustments, and many cures each of which is the "cure-all." The interesting feature of this is that every system and plan expounded by modern sociologists and economists has been in operation at some previous period in the world's history, and none of them has ever proved to be a permanent panacea for restless human beings. Democracies, Republics, Monarchies we are all familiar with in the history of Europe. Even "State Socialism" has taken many forms; the Roman Empire was conducted upon a system which was in fact a kind of state socialism. China in ancient times was a completely organized state whose officials regulated the life of the Chinese people into their remote parishes. Germany is the best modern example of State Socialism; it is, however, often termed an Autocracy, an anomalous *finalé* of a mechanically organized State.

"Democratic Control" is a new phrase but it is also an ancient aspiration; it has been tried many times, and in Asiatic history it was the undoing of many civilizations. The migrations from one continent to another and to a different part of a continent were additional evidences of the desire of the people to control their own destinies. The history of Greece and of Rome reveal many popular risings and several experiments in "Democratic Control" of government. More recently, France has shown the "people" trying their hands at righting things. Nevertheless, true liberty, equality, fraternity are not realized in France to-day in a greater degree than in many other countries.

"Guild Socialism" is another social formula advocated by some thinkers in England to-day. But it appears that India under its thoroughly organized caste system had what might be called a form of Guild Socialism.* During the middle ages industry was carried on by Guilds of Craftsmen in Europe and in England. Various reasons are given for their decay, but the inevitable urge of Bergson's *élan vital* may have had something to do with it. Certain it is that evolution *is* too creative to allow one good custom to corrupt the world for long!

Now the probable truth of the matter is that every form of government is ideal in its conception. We can imagine an ideal Autocracy, at the head of which is a monarch so wise that absolutism is safe in his care; he chooses wise ministers to manage the affairs of the nation, and the interests of all are preserved.

We can imagine a perfect Caste or Guild System, in which each Guild has its function and every member of the different Guilds realizes his place in the whole scheme, which works together for the good of all.*

We can imagine a Republic of States so beautifully balanced within themselves that there is no friction between the parts; where each Republican exercises his highest capacities without partisan disturbances, and none is for his party, but each one for the State.

Ideal Democracies we have also dreamed of, though, perhaps, with less confidence. The prophets, apostles and leaders of the people have been many during the last one hundred and fifty years all over the world. They have conceived of an ideal humanity, of a race of men so developed that with complete self-consciousness and understanding they could "govern themselves" by choosing their own administrators from amongst themselves; a race of men wise enough to know that they themselves constitute the state and are individually responsible for the form of government under which they live; in a word, "government of the people, by the people, for the people."

There were such idealists in America toward the end of the eighteenth century who drew up the Constitution of the United States of America and declared that "all men are born free and equal." There were such idealists in France who fervently sought to establish an ideal Democracy on the basis of Liberty, Equality, Fraternity. In England *The Rights of Man*† were ideally expounded by Thomas Paine. Later, Italian patriots rallied round Mazzini to free Italy and to establish an

* See "What has India contributed to Human Welfare?" by Dr. Coomaraswamy, The Supplement to *The Athenæum*, Oct. 2, 1915.

* This system is well thought out and presented in *National Guilds*, by A. R. Orage.

†Now published in "Everyman's Library."

Association of the People.* During the same period revolutions in other countries, notably Russia, sought to give Democracy expression.

History, however far back we go, reveals man as an idealist. He feels the Hero potential in the race. Hence all his experiments at creating a perfect social organism. He repeats the same idea in many forms and never tires in making new attempts to establish his ideal on earth.

As in their conception, in their ideal forms, all systems of government are perfect, if they were carried out as they are conceived a civilization would result in which justice is accorded to each individual. The form is relatively unimportant if the mental and moral characteristics of each are taken into consideration and different interests are harmonized.

What then is required to bring to expression any ideal social system ?

In a perfect absolute Monarchy we pre-suppose a wise monarch; in a perfect Republic we pre-suppose wisdom to inhere in the officials of the state ; in an ideal Democracy we require the people to be imbued with wisdom. But, *until men are agreed as to what wisdom really is, the world will continue subject to experiments in social institutions.* When they attain to true wisdom the people will peacefully govern themselves and Autocracies, Republics and Democracies will be found *au fond* to be much the same thing.†

Lao-Tze, an ancient Chinese philosopher and friend of Kings, said :—

" A free and generous government gives the people a chance to develop.

" When the government is rigid and exacting, the people are cramped and miserable.

" Therefore the wise man says : ' I will design nothing, and the people will shape themselves.'

" The wise man is full of rectitude, but he does not chip and carve at other people.

" The difficulty in governing the people is in having too much policy.

" The state should be governed as we cook fish, without much business.

" The man who commands well is not imperious."

If the Democracy should ever attain this ideal, nations would be well under either an imperial or democratic form of government. But that which is necessary, under either or any system, is Intelligence, and any process must be desirable that will develop this. In order to be effective, wise " rulers " must be recognised as wise by the people, and this recognition implies wisdom and intelligence on the part of the Democracy. What then, finally, would be the difference between an ideal Autocracy and an ideal Republic ?

In the meantime, however, the essential thing for any progressive state, whatever the system of government, is an increasing attainment of Intelligence. That power, position or money do not contribute to Intelligence is evident by the state of civilization to-day. Idlers, spendthrifts, ambitious office holders and greedy " commercialists " are found in all classes as wealth increases, and they do not illustrate intelligence, rather they exhibit those personal passions inevitable in the process of the development of individuality. It is only by means of experience, under the action of the law of equilibrium, or cause and effect (the Nemesis of the Greeks), that individuals will gradually attain Intelligence.

There is really something *naïve* in the confidence with which different writers advocate State Socialism, Democratic Socialism, Liberal Socialism, Guild Socialism, a Union of Democratic Control, etc., as systems to be applied for the remedy of the glaring evils brought about by the " Individualism " which, during the last one hundred years or so has stimulated the development of Intelligence in various classes in all countries. For the imposition of any system will not *in itself* increase Intelligence. Social systems, no matter how perfect in conception, must be directed by admittedly imperfect human beings ; and an organization as perfect as the Solar system could be wrecked by unintelligent men.

" To perceive things in the germ is

* See *The Duties of Man* also in "Everyman's Library." Mazzini disavowed individualism as preached by Thomas Paine and the French Revolutionists. But his idea of Associations for Mutual Service was possible only after the awakening brought about by the individualistic propaganda. Strong associations require strong individuals.

†*The New York Evening Post* reported recently a conversation with a prominent Chinese business man, who said that it was a matter of indifference whether China were a Republic or a Monarchy. What was essential for the progress of that country was that it should not be subject to frequent changes of Government officials. These revolutions were engineered by office-seekers and the turmoil of transition from one government to another is distinctly disturbing to industry and the business interests of the country.

intelligence," said Lao-Tze. "All difficult things have their origins in those that are 'easy'; and great things in what are 'small.'"

"Things in the germ" are the fundamental laws of existence, the Principles in which we live and move and have our being. The germ is "the seething principle," that "well kept latent germ, the Centre," around and about which, men and their nations and states rise and fall and rise again.

Man's search for the fundamental law of existence springs from his very constitution. His faculties, his reason and intuition, suggest to him an Ideal for human society, because all civilizations he has known have fallen short of that perfect balance which he seeks in his many experiments, and which he sees adjusted so nicely in those regions of the Universe over which he has no direct jurisdiction. The solar system, the earth's nights and days and seasons, the action and re-action of the chemical elements, the growth of cells, the propagation of species, the behaviour of heat, light, electricity, etc., all apparently are grounded in Intelligence and act in the nature of things according to laws that are so and could not be otherwise.

Chemical, mineral, plant and animal life all exist as rhythmic expressions of these laws. Man, however, has attained to a certain degree of self-consciousness, and, ages ago, repudiated the semi-conscious existence of organisms, which, however perfectly adjusted in function, could not express his desire for self-conscions, responsible existence. Therefore he undertook to *consciously* form a society consisting of human relationships that depend on individual initiative. Thus man is responsible for his civilizations.

Now Democracy in its real modern meaning signifies the general awakening of men to a sense of personal responsibility to Society and for its administration. And this intensive feeling for life has furnished the material out of which the big modern States of Europe and America have been built. The imaginations of the people were fired by the conception of a United States of America, of a United Italy, a Greater Germany, a British Empire! If the people had not been interested no co-ordination of states could have been accomplished. But that the people themselves constitute the State has not yet been realized by them to any serious extent in any country. They still look upon the State as something separate and external; in some cases, as something superior to them, though constituted of officials like unto themselves. Therefore it comes to this that every people has the government suited to its understanding, and the world as a whole is regulated pretty much according to the average intelligence of men.

Each nation is distinctly individual and has its own temperament and ideals, although the wise men of every age and race have all seen the same Principles latent in humanity and have all made the same fundamental statements regarding man's nature and destiny. And the different types and temperaments of nations have given opportunity to discover these Principles in operation under various guises.

But the wise men have been few; barely sufficient to keep alive from age to age the memory of what humanity is seeking. The dreams of idealists have never yet been realized on earth, because their expression required the acquiescence and understanding of more people than have yet attained to this Intelligence. The laws and social institutions of each nation express approximately the average outlook, bias and development of the people of the country. Tradition grows up in this way and a nation gradually becomes fixed in its ideas until in time its iaws and customs are petrified, decay sets in and only the skeleton of a nation remains. The reason for a periodical change of system is therefore evident. Circulation is a *sine quâ non* of Life* and so even the long-established caste system of India is disintegrating. At one time Peru contained a highly-developed race of which there is nothing now but "remains." In North America there was a marvellous civilization ages before it was "discovered" by Europe to be inhabited by Indians, the decadent remains of a former splendid race. Egypt was the scene of many a rise and decline of civilization where scientific knowledge was greater in some respects than ours.

The forms of "matter" are not eternal; all are subject to change, and for this reason no civilization can be retained permanently in a given system. Its life escapes. In general the most advanced types of human beings are found in the newer nations.

Inter-nationalism, however, presents a

* The Study of Science indicates this.

factor that appears to be new in the history of the world. Through it a Principle seems to be emerging which may contain a clue to the mystery of human evolution; it may suggest a means by which mankind may in time be preserved from the constant actions and re-actions of past history and all nations may then advance together.

The circulation which is essential to virility may find its channels in exchange between nations. This inter-nationalism has always existed in the realm of ideas, in Philosophy; for the best philosophy that has remained to us from all ages and races is fundamentally the same. In Science this inter-nationalism has also been developed; its laws in every branch are found to be the same in whatever country they are studied. Commerce is the means by which exchange between nations has been effected on physical levels. But the methods of exchange are conditioned by the philosophy which each nation has accepted or evolved. The thoughts of a people take form in their social institutions, in their trade regulations and agreements, in their fiscal systems, etc. Whatever be their philosophical doctrines, as accepted by the average intelligence, these are seen expressed in their manners and customs and laws.

It is therefore evident that inter-national Philosophy and Science, and even the study of Comparative Religions, have not been carried far enough yet to secure a working basis for physical or geographical inter-nationalism.

The philosophy of Free Trade between all nations is sound and based on fundamental principles, for open ports the world over would secure the circulation necessary to prevent stagnation, and the natural laws of supply and demand would adjust balances. But Free Trade will not become a fact in the world until the nations are really *thinking inter-nationally*.

As fiscal policies both Free Trade and Protection have their sincere adherents who seek to find a method for the adjustment of the various factors in society both intra- and inter-national. The problem of supply and demand is at bottom the same as that of the balance of power in politics, the problem of resistance in physics and electricity, etc. All sciences and arts when they come to be applied must satisfy this law of balance if the result be satisfactory.

As indicated previously in this article, this is the problem men have to solve before civilization can express that harmony apparent in all realms of Nature not controlled by man. In Science and Art it is never solved by imposing on materials or forces a *theory* which a scientist or artist would personally like to prove; the solution depends always on the discovery and application of the law which expresses in that particular science or art the universal Principle of Equilibrium or Balance.

This Principle seeks expression everywhere and men suffer individually whenever it is violated in personal relationships, in business, social or class dealings. Indeed the different parts of the nature of one man may be out of harmony and clash with one another so as to lead to disharmony also in his outer relationships.

The problem then for men is infinitely complex; it begins with each single man and ends only with the vast issues of inter-national life. Is the truism not true then that "The proper study of mankind is Man"? The intelligence to which the average man has attained, his power of poise and balance, is the measure of the stature of nations and of the world. Many men have learned to think nationally in the personal sense, as many others think personally of their own class or individual interests as against others. But as the latter tendency will not build up a coherent nation among a people, neither will thoughts of national domination on the part of single nations develop an inter-national or world-civilization.

No nation has yet attained true equilibrium within itself, nor can this be said except of a comparatively few individual men. No man and no nation can accomplish such a task independently of others. The progress of even the most advanced ones is limited by the condition of the whole. Each nation must first seek to balance conditions within itself and with others; and this involves, *pari passu*, the recognition of the necessity for others to do the same, and for each to take what steps are necessary for self-protection and development.

SCIENCE AND INDUSTRY. By PROFESSOR SILVANUS P. THOMPSON, D.Sc., F.R.S., M.I.E.E.

One fine day in the first week of September, 1891, four men were lunching together in a private room in the Frankfurterhof Restaurant, Frankfort. It was during the Electrical Congress and Exhibition held in that city. The four men were: Leopold Sonnemann, editor of the *Frankfurter Zeitung*; Emil Rathenau, director and founder of the Allgemeine Elektricitäts Gesellschaft; Colonel P. E. Huber, founder and director of the Oerlikon Machine Works, of Zürich; all men over fifty years of age; and the fourth, their junior by nearly twenty years, was myself. I am the sole survivor of the group. Sonnemann, a distinguished figure, was President of the Frankfort Exhibition. I was one of the five Honorary Vice-Presidents; the other four being Werner von Siemens (Germany), Thomas A. Edison (America), A. von Waltenhofen (Austria), and Marcel Deprez (France). Engineer Oscar von Miller was chief engineer of the Exhibition. The great Professor H. von Helmholtz was Honorary President of the Jury, the actual Presidents of the Jury being Professor Kittler and Mr. (now Sir) William H. Lindley. Of the many notable features of the Exhibition by far the most important was the demonstration of the electrical transmission of power, namely 100 horse-power over 100 miles, from Lauffen, near Heilbronn, to Frankfort. The electrical transmission of power was then a very burning question. There had been small experimental demonstrations, indeed, at Solothurn in Switzerland, and from Creil to Paris. But in 1891 to send 100 horse-power over 100 miles was a startling departure. Moreover, the projectors had the hardihood to employ for the first time the recently devised system of three-phase alternating currents, an entire novelty. If this daring project should succeed what a vista would be opened out! Already engineers hinted at the harnessing of Niagara, and the adoption of electric propulsion on railways. If it should fail, then all such schemes would be indefinitely postponed. Such were the momentous issues. The actual distance was 110 miles. To transmit 100 Horse-power with an efficiency of 75 per cent. through three copper wires, about $\frac{1}{8}$ inch thick each, would necessitate an electric pressure of no less than 8,000 volts, then considered both enormous and perilous. The lines would have to cross the territories of four separate states from Würtemburg through Baden and Hesse to Prussia. At the rapids of the Neckar at Lauffen, with a fall of about 12 feet, turbines were erected to drive two alternators built by the Oerlikon Works from the designs of Brown, with transformers to raise the pressure to 8,000 volts. At Frankfort, transformers were again employed to lower the pressure, and a special three-phase motor was constructed by the A.E.G., to the designs of Dobrowelsky, to reconvert the electric power into mechanical motion. Engineer Oscar von Miller secured the co-operation, with these firms, of the Imperial German Post Office which undertook to lay out the transmission line and to lend the timber posts. The firm of Hesse lent the sixty tons of copper wire; another firm supplied the necessary thousands of large porcelain insulators. On August 5th the lamps of the Exhibition were lit, and an artificial waterfall was worked by the power transmitted. Thousands flocked to see the triumph, and frequented the Exhibition day after day. But when the Jury came on the scene preparing tests to ascertain the percentage of efficiency of the transmission, a serious difficulty arose. Qualms of doubt seized even the most capable engineers, and great scepticism prevailed as to the probable result of using three-phase currents for the transmission. The conditions were novel. Engineers were without experience of very high voltages over so long a line, passing over mountains and through forests, and at one place running through a damp tunnel. The representatives of the Allgemeine Company and of the Oerlikon works, though they did not object to the efficiencies of their particular machines being tested, demurred to any test being made of the transmission as a whole. They feared that either by leakage at the porcelain insulators, or from some unknown source of loss occasioned by the capacity of the lines, the efficiency of the transmission might possibly be reduced below even 50 per cent, and so discredit might be brought on their machines. The expressions of these fears in private had almost led to a prohibition to the jury to ascertain how much of the horse-power put in at Lauffen was actually received at Frankfort.

Such was the state of things when I found myself invited by Herr Sonnemann to confer with the two directors of the manu-

facturing firms. At this meeting these doubts and difficulties were carefully put before me, and on the other hand I was frankly told of the disappointment that would be felt if the jury were prohibited from making the full tests. Already I had examined for myself the running machinery, the transformers and the transmission lines. It was clear to me that the generators were excellent and could not in themselves have an efficiency less high than 90 per cent.; that the principal motor, though a little weak for its work, could not have any much lower efficiency. So far as I could judge, the transformers and the transmission lines could not possibly waste 20 per cent. of the power. I was therefore disposed to expect an over-all efficiency of at the least 60 per cent., and probably as high as 70 per cent. I strongly urged that even if the efficiency should turn out to be only 55 per cent., engineers would regard the undertaking as an established success; whereas if no complete test was allowed they would be suspicious of a failure, and would condemn it. It was hard work to convince the two experienced directors that they had no real grounds for fear. What precise weight my arguments carried I shall never know, doubtless others were consulted in the matter. But the upshot was that the jury was given a free hand; and after a month's elaborate experimenting Professor Weber, of Zürich, was able to report that the over-all efficiency never fell below 68 and at times exceeded 75 per cent.

I have, at the risk of seeming personal, given this piece of private history because the affair stamped vividly on my mind, a thing which the whole management of the Exhibition demonstrated, the immense and mutual gain which accrued from the hearty co-operation between science and industry. Had the manufacturers not appreciated the vital importance of having scientific principles fully wrought into their designs and projects; had the trained scientific men who advised them throughout not been trusted by the manufacturers; had the commercial directors not been willing to lay out money on the strength of scientific advice; had the scientific men not been for long periods in active contact with the development of industrial applications; above all had not the governing authorities, imperial, administrative and municipal, been in cordial co-operation with both manufacturers and men of science, this great and far-reaching demonstration could never have been brought to success. It may be mentioned that the German Emperor himself contributed 10,000 marks towards the expenses of this unique undertaking. Let me add that in the whole affair there was no nonsense about trade secrets, or any concealment of matters which it would profit manufacturers at large to learn. As a result the whole industry benefited.

Let me turn to a different chapter in the relations of science to industry. There is no industry in England to-day which presents a more deplorable picture of the results of failure to co-operate for national and common good than does the glass industry. It is in few hands; its businesses are for the most part old established concerns enjoying considerable reputation, managed by partners or directors of unquestionable integrity, who have for years been faced with difficulties attendant on production, difficulties such as few others have had to encounter in the way of restrictions imposed by the trade unions. The Glass-workers' Union is notorious as probably the most obstructive and unpatriotic in England. Glass workers have indeed a black chapter of set-backs to British trade to their discredit, not the least of these being their recurrent opposition to the introduction of scientific improvements. This has reacted on industrial progress. What would be the use of manufacturers laying out capital on making improvements in their plant, and on their methods, if they were to be for ever thwarted by the uninformed opposition of the workers? It is an old tale, this complaint of the supineness of the masters and the obstructiveness of the men. Result: foreign glass works, in which scientific development is possible, progressing by leaps and bounds; while cheap imported glassware injures branch after branch of British manufacture. For over thirty years the telescope makers have been complaining that they have not been able to get glass discs suitable for making the lenses of large telescopes. English glass-makers could not or would not be at the trouble of such manufacture; the demand would be too small. Why, the total requirement would not amount to five tons per annum of this sort of glass. Let the French makers make it. The makers of thermometers needed a special sort of glass which should be able to withstand rapid heating and cooling without showing as most glass does, a persistent con-

traction when cold. Would the glass manufacturers in Great Britain trouble to make such a glass or permit their works' chemists to spend time on search for the best composition for this purpose ? Not they ; let the thermometer trade go to Thuringia, and let English factories be relieved of any bother of chemical research. Are steam gauges wanted of a glass that will endure hot water uncorroded ? Send to Germany for them. Are glass chmineys needed, of special glass to withstand cracking when used to protect gas-mantles ? Here was a new branch of industry arising out of the invention of the incandescent mantle. Who would discover the best kind of glass or the most expeditious way of blowing those shades ? Oh, leave it to Holland or to Saxony. The chemical analysis would cost too much ; and moreover our workmen would oppose any improved method of blowing the glass. Is special baryta crown glass wanted for the best kinds of camera lenses ? Oh, the baryta ore in the English market is not pure enough ; and, besides, special melting pots would be needed. Don't let us trouble about it : let the opticians import it from abroad. Then the war breaks out, and we discover serious shortages in optical glass, in thermometers, in chemical glassware, in steam-gauges, in lamp chimneys, and in a score of other glass commodities the manufacture of which has been driven out of England.

Two decades ago there came along an inventor to whom there had occurred the idea of making an unbreakable glass for factory-windows or roofs by embedding wire netting in the substance of the sheet. An excellent notion ; and entirely practicable, as the inventor finds from a few specimens which, not without some coaxing and pushing—and at his own expense—he has at last persuaded a leading British firm of manufacturers (and keen tariff reformers a few years later) to make for him as samples. So far, so well : but it was a wholly different matter to induce any firm of British glass-makers to take up the new line of manufacture. Messrs. X of London, and Messrs. Y of Birmingham, and Messrs. Z of Lancashire are much too well off, and too satisfied with their own trade, to father a new British industry. There is nothing here to appeal to the greedy imagination of the company-promoter in the City. And so after disheartening months have elapsed the patentee drops his patents. Less than two years go by, and this very product of unbreakable glass is boomed upon the British market as the last new Yankee invention ; while it is triumphantly announced that the leading firm of Messrs. Z of Lancashire will act as agents for its importation into Great Britain.

But why should one stop reciting such stories ? Only last month it was announced that a certain American glass works, after considerable research and scientific study with the spectroscope, have just discovered a blue-green sort of glass which, when used for the bulbs of tungsten filament lamps causes their light to resemble daylight—the very quality of light desirable for lighting picture-galleries and studios. Doubtless to the credit of the American. Doubtless also, to the discredit of those British lamp firms who two years ago were themselves ahead in this matter, were two years ago using in this country a glass of similar properties—and have now ceased to manufacture such lamps ! Why, I myself opened a discussion on the merits of these daylight lamps at the Society of Illuminating Engineers nearly two years ago. Now that British makers have dropped them, we shall probably see them shortly imported from America as being the latest novelty in lamps. One reason why they have been dropped here is that the commercial travellers know no science : a reproach also too true in almost every industry, and doubly disastrous in foreign trade, where the travellers of foreign competitors are mostly men technically trained, as well as good linguists.

Incidents of this kind do not encourage men of scientific training to regard hopefully the attitude of British manufacturers. Whatever betterment the future may witness, the past has been disastrous enough. And not in the electric line, or in the glass line alone. Let the story of the British dye-stuff industry, and of its decay, be once more a warning. The indigo planter of India, and the woad farmer of Wisbeach, interested parties both, denounced the chemically manufactured dyes, however pure, as an inferior imitation, regardless of the fact that the chemists had discovered literally hundreds of new dyestuffs, some indeed fugitive, others more permanent than woad, or indigo, or madder. How the German dye-stuff industry flourished by the cultivation of science, and the British industry languished by its neglect, is an oft told tale. The sugar-refining industry and the synthetic drug industry are, alas, mere chapters in the

same catalogue of disasters. Belittle the teachings of science ; ignore the expert trained in science ; carry on your works without him ; if you must have him, pay him less wages than you pay a fitter ; put him under non-technical directors and managers who know no science. Then, when, after years of this neglect, your chickens come home to roost, and you find that the progress which ought to have been made here is made in foreign countries instead, blame the patent laws, blame the lack of protective tariffs, blame the Trades Unions. Blame everything and anything except the chiefest cause—the blindness of manufacturers and men to the truth that *that industry is doomed whose leaders despise and neglect science.* It was so before the war ; it will be so after it.

To remedy this state of things much is needed. (*i*) A remodelling of all education in all branches, to remove the disadvantages which arise from men devoid of any idea of scientific method growing up into civil and industrial life. (*ii*) A reconstruction of the Universities as centres of earnest work from which idlers and triflers are rigidly excluded. (*iii*) A radical change in the meaning borne by University degrees, to ensure that they shall be the mark of thorough training under competent teachers, and not mere attestations of cleverness in passing examinations ; so that men shall wish to go to a University, not in order to get a degree, but to receive there a training infinitely more valuable than any letters after their names. All this is preliminary and will take years to produce its full effect. The industries must make more use of such aids as are afforded by the laboratory departments of the Universities and Technical Colleges. What the National Physical Laboratory has done in aid of the scientific industries at large, the local laboratories of the Colleges may do on a small scale for local industries. And the leaders in the industrial world must see to it that the local Universities do not degenerate into degree-grinding cramshops, but that they take (as for instance the University of Sheffield is taking) an effective part in helping the scientific advancement of the local industry. In turn, it will richly repay the industries to help the laboratories of the Colleges, to equip them thoroughly, and to ensure that they are directed by men who carry scientific weight. A very significant movement is already in progress in the United States. There, to a degree unheard of in Britain, it has been for many years the practice of some of the great industrial concerns, in engineering, metallurgy and the chemical manufactures, to ally themselves with the Universities, both by aiding to equip the laboratories, and by competing amongst themselves to secure the ablest graduates as assistants on their staffs. This method of bringing science into the factory by securing highly trained young men to become the future heads of departments and managers, and chiefs of staff, has been of enormous advantage, yet it has not been found sufficient. Several of the largest and most prominent of manufacturing organizations have now found it expedient to equip and maintain elaborate research departments and scientific laboratories in the factory, to push forward scientific advances within the industry. And the research department not only undertakes researches, involving time and money and trained ability, but helps to perfect the scientific and technical qualifications of the younger assistants. More remarkable still, members of these research staffs are allowed and encouraged to publish from time to time bulletins of the scientific and technical advances so maintained. The two great electrical organizations in the States—the General Electric Company of Schenectady, and the Westinghouse Electric Manufacturing Company of Pittsburg, have led the way in this enlightened policy. Not one of our English-grown industrial concerns has anything like this to show. We are twenty years behind the States in our appreciation of the importance of science to industry. Perhaps it is equally true to say that in our Universities we are twenty years behind in our appreciation of the importance of the industries to science ; even so this is but a part of the failure of the nation at large to grasp the fundamental importance of scientific training.

Until we have made good our backwardness and blindness it will be mostly idle to talk of Great Britain capturing the industries which have been destroyed on the Continent of Europe by the great war. If she could capture them she could not maintain that capture, her factories not being staffed with men of scientific training. You cannot in a year, no nor in two years or three, train up a staff of men to scientific thinking or working, any more than you could train these same men to be violinists capable of playing in an orchestra. Neither can factory

laboratories be created out of hand. They must grow and develop according to progressive industrial needs; and the men to develop them must themselves be evolved. They cannot be imported ready-made from the Universities or Colleges: neither can they be produced from the ranks of a commercial staff, even the ablest, if untrained in science. In persistent collaboration and co-operation of industry with science lies the road to progress.

ELECTRICAL FINANCE AND INDUSTRIAL BANKING. By T. C. ELDER.

It is out of savings that engineering plant and machinery are bought. This branch of industry is peculiarly dependent on the maintenance of a certain volume of capital investment. Textile and most other manufactures are sold over the counter and paid for, as an accountant would say, out of revenue—wages, salary or income; but the purchase of machinery is commonly a direct investment of capital raised for the purpose. The construction of a new railway, the extension of an electric generating or transmission system, the building of an ocean liner, the re-equipment of a factory—all these are primarily financial operations.

That is why the engineer must always be knocking at the door of the financier and the banker, or at any rate, it is not till that door, and the door of the safe as well, is opened that the engineer can get to work. But in England, which is the world's great financial home, and which is or was the home also of modern engineering, the relationship between the money market and the machinery market has never been quite comfortable and sympathetic.

In Germany, and to a less extent in certain other countries, there has on the contrary been witnessed an offensive and defensive alliance between finance and manufacturing, and for the past twenty years we have had repeatedly to ask ourselves why cannot we have a similar system of industrial banking here, which would lay a smooth high-speed track for engineering prosperity?

It is a subject so big and so complex that in the space allotted to me I can only cover the ground by ignoring numerous important side issues. The first thing necessary whenever this question is discussed is to form a clear conception of the special position and character of British joint stock banking, and to understand how, in the absence of the system known as industrial banking, which may be defined presently, new enterprises involving business for engineering firms are financed in this country.

The typical British joint stock bank takes deposits from the public, and with the money carries on an aristocratic pawnbroking business, lending on "approved security." Its turnover is so much larger than its paid-up share capital that it is in this simple way easily able to pay a high rate of dividend. The typical bank manager is expected to be a judge of the value of paper and to avoid anything in the nature of a lock-up investment. He is, in fact, merely a respectable usurer. He knows nothing about the intrinsic merit of any department of commerce. Like the pawnbroker, although with much less variety of experience, he leaves himself a safe margin when lending on security, and he keeps always on his desk a list of Stock Exchange quotations and some account of the condition of the property market.

Nothing can be done on such premises for, let us say, a group of British engineering firms hopeful of promoting a water-power scheme in Spain or a railway in Tibet, and thereby securing large contracts for British labour. What is their alternative? Nothing else but to make a tour of the "financial houses," whose inhabitants, whatever title they may prefer to give themselves, are simply underwriters. And these people, just like the bankers, have never been trained and have never felt any need for the study of intrinsic commercial merits. They too keep one eye all the time on Stock Exchange movements. The sole aim of their professional existence is to discover in advance what sort of security is going to be run after by the public, and to get hold of it first; and they have naturally tricks of their trade for deliberately inducing a public appetite, although they are rarely very successful.

The supply of new capital for creative business enterprise comes like a series of gushes from a defective hose-pipe. You never know in which direction it will squirt or in what strength or volume. A more familiar explanation is to describe it as an irregular system of booms. If there is a rubber boom anyone

who cares to print a prospectus inviting subscriptions for planting rubber trees in the most unlikely spots can get a friendly welcome. If it is oil that delights the fickle public any slice of Sahara or claim pegged out in Greenland's icy mountains will serve to float a company.

There have been booms in railways, home and foreign, in mines, in tramways and electric lighting, and it is only fair to say that even rubber and oil investments bring some grist to the engineering mill. But it is exasperating to British makers of machinery that nobody in the City gives a thought at such times to the manufacturing interest. How many millions have been raised in England and spent unnecessarily on foreign plant cannot easily be estimated ; but it must be a colossal total. South African mines furnish perhaps one of the worst examples, while on the other hand Argentine railways have been in very large proportion not only financed, but also equipped by Britain.

It would seem to be the most natural thing in the world that when we find capital for enterprises abroad, we should try to advance this capital in the form of British manufactures. But the average financier renounces any obligation of the kind. For the purposes of his business as a money merchant, he is content, and even eager, to regard London as a cosmopolitan market place. The London Stock Exchange might be somewhere across the Channel for all the interest it takes in the workshops of Manchester or Leeds, and both company promoting practice and the centralized joint stock banking system have been cleverly and persistently exploited to the advantage of Germany's industrial expansion.

It is again, as in the case of many other grievances, largely our own fault. The Germans studied better how to use this cosmopolitan money market, and were rewarded accordingly. The much admired and envied German industrial banking system had a substantial portion of its foundations in London, and bank managers would give a pleasanter welcome to a German bill broker than to a British manufacturer needing the wherewithal to carry on or extend his business, while the company promoter and underwriting firm would refuse to concern themselves with any notions of securing orders for native works.

If the Germans made artful use of the London money market for the aggrandisement of their manufacturing industry, it must be admitted that they were also exceedingly skilful in their mobilization of the savings of their own people. It is a common error to assume that there was something inherently unsound in Germany's business expansion, and that things were always tending to a crash sooner or later. No doubt there is a danger in any country that the boiling pot may boil over. Financial cleverness is apt to run readily into over-cleverness, and a long series of successes in the negotiation of commercial risks leads men into temptation to more hazardous ventures. But as a system the co-operation of Germany's finance and industry was soundly and shrewdly conducted. The banks did not rely on mere stock jobbing experience. They availed themselves of the services of the most competent commercial and technical experts. They went into no new enterprise blindly, and when they gave long credit to certain classes of foreign customers they knew very well what they were about. Bankers would sit at the board of manufacturing companies. Business organizers would assist in the direction of banks. And between them, as the nursery rhyme puts it, they licked the platter clean.

A factor in this calculation that is nearly always overlooked is the rate of profit earned as the normal expectation of a manufacturing industry. For it may readily be imagined that the banker and the financier will treat with some respect the business that pays its steady 10 or 12 or 15 per cent. It is on such rates of dividend that the German banker grew richer, and it is such manufacturing companies that in the absence of trading banks can afford to finance foreign contracts or subsidiary companies. They are somewhat rare in British engineering, and when you do come across them you will probably find that they act as finance companies as well as manufacturers. A significant example was furnished by the change of title of the largest railway rolling stock company two or three years ago, now the Metropolitan Carriage, Wagon *and Finance* Co. The leading electric cable companies have for years pursued this policy of encouraging good customers and so have the armament firms. The case of Vickers is particularly suggestive. By successive increases of its share capital this

company has been able to finance tributary enterprises abroad, and has thrown off a number of satellites in the shape of smaller manufacturing companies in this country. It could only do so because of the good dividend paid by the parent company, whose satisfied shareholders would entrust it with further millions, but would be much more difficult to persuade if it were a matter of direct investment in a new works not likely to pay a substantial dividend immediately after its birth.

But for limitations of space I should have attempted to throw further light on the curious courses of industrial finance by describing the methods adopted—and necessarily adopted in the absence of any practical alternative—in the promotion of, for example, the London Underground Railway system, and of those electric supply and traction undertakings which escaped commandeering by local authorities. And the subject could not be discussed exhaustively without also examining the deadening effect of municipal ownership on certain sections of the industrial investment markets. The money for a municipal tramway scheme is provided not by tramway investors, but by holders of local loan stock. However successful commercially the undertaking may prove, that has no effect whatever in widening the circle of eager tramway investors. As a direct investment tramways and electric supply are judged solely by reference to the results of private companies; that is to say, on evidence which is partial and misleading, and consequently it has been found impossible to create an important Stock Exchange section and rally a force of steady investors such as will faithfully support railway stocks.

To return to our main line of enquiry, is it not apparent that having started by discussing the difficulty of getting loyal and active support from banks and financial houses we have arrived at a stage at which we get at least a glimpse of an alternative method? Is not the rate of remuneration earned by engineering capital after all the chief influence? A manufacturing company of large capital returning a steady substantial dividend has the equivalent of an industrial bank in its body of shareholders, who are usually ready enough to subscribe proportionately any issue for the purpose of financing some subsidiary enterprise. In no country is it, on the other hand, easy for a less successful company to go to an industrial bank and get support. I fear that some of those who dream of the introduction of the continental method credit industrial bankers with semi-philanthropic motives. Their habit is, on the contrary, to march to victory with the big battalions. They are not at all fond of financial forlorn hopes.

Our best British plan, therefore, is to develop and intelligently vary the system of making *pro rata* issues to satisfied shareholders. It may be an offer of the manufacturing company's own remunerative stock at a price slightly below the market quotation. Or it may be an issue of the new shares of a subsidiary to which the parent company can guarantee a dividend. Or again, there is something more to be done in the way of guaranteed issues made jointly by several manufacturers or contractors engaged in some important scheme. It is usual in all such cases to secure the support of underwriters, but it would sometimes be wiser to give the shareholders this opportunity to become themselves the underwriters; because the professionals will naturally unload as soon as possible and thereby depress the market valuation in securing their narrow margin of profit with which they are satisfied.

It is by no means beyond the limit of practicability for the B.E.A.M.A., acting in concert with other engineering associations, to establish an underwriting stronghold in the City of London, a financial house which would have the advantage of expert knowledge, and which would give a lead in engineering investment. Such an institution would be in a very advantageous position for distributing such limited risk as it might undertake, for it is the first step that counts in the City, and if an underwriting list has some powerful house to give it a "substantial commencement" further supporters can be rapidly recruited. The American £10,000,000 finance company, which is announced for the purpose of making openings for United States manufacturers after the war, would doubtless proceed somewhat in that manner, and would certainly make use of the London Money market. In fact, if we may expect to go back to pre-war conditions this American syndicate will play the same game as continental groups have so frequently and so profitably played. For an example, let us take the Anglo-Argentine Tramways Company.

Its registered office is in the City of London, and it has much British capital invested; but if you wanted to do business with it you paid a visit to a handsome suite of offices in Brussels. You were there in a friendly country and there really was business to be done on behalf of British firms. But if it had been Berlin instead of Brussels the quest would have been hopeless. We need only recall the case of the Victoria Falls Electric Power Company.

What has been done in the past by German, French, Belgian and American syndicates or industrial banks in exploiting the money market could probably be imitated by a native financial institution, specially concerned with engineering enterprise, and with the duty of keeping the investing public enlightened; but the analysis of such proposals must be deferred for a future occasion. My present purpose is simply to direct attention to what I believe to be the British alternative to industrial banking, namely, the more systematic shepherding of existing investors in engineering, which means the more carefully studied encouragement of re-investment by the large number of engineering shareholders who have been already well repaid. That may be cold comfort for the companies that have not been able to pay good dividends; but in any case their finance must be the subject of a special effort. They are just needy borrowers, and no industrial banking system would pave for them a royal road to easy prosperity.

INERTIA can be conquered only by enthusiasm, and enthusiasm can be kindled only by two things: an ideal which takes the imagination by storm and a definite, intelligible plan for carrying that ideal into practice.

UNFAIR HANDICAPS ON BRITISH EXPORT TRADE. By FRANK BROADBENT, M.I.E.E.

Unfair Handicaps! Why, how can a handicap be anything but unfair? Would not the term "fair handicap" be a contradiction of terms?

So it would seem at first sight, because when our minds are concentrated on business problems, the true meaning of words is sometimes obscured, or a false interpretation is attached to them. I cannot say, off-hand, what, by derivation, the word handicap really means, nor is it worth while to consult Johnson on the subject, for on reflection I remember that one is rather pleased than otherwise to be handicapped at billiards, golf, shooting, or any other form of competitive sport.

A handicap is really a thing to be rather proud of—it indicates that the other fellow would not have a chance if we competed on equal terms. Handicaps are applied in practically every kind of competition and are really a means of ensuring, as far as is humanly possible, *equality of opportunity*. An unfair handicap is one which destroys this equality, hence a boxer might justifiably complain that he was unfairly handicapped if the referee permitted his opponent persistently to hit low; and a runner would be unfairly handicapped by an opponent who wilfully obstructed him by "boring."

The principle of handicapping is based on a recognition of the fact that one of the contestants is better than another. Either he possesses special skill due say to study or application, or he may possess natural advantages which his opponents lack; or, in some way or other he is superior to his rivals. From this point of view therefore a handicap may be looked upon rather as something to be desired than otherwise.

Leaving the realms of sport, used merely as a readily available and easily understood illustration of the meaning of handicap—and turning to purely commercial matters, we find that industry may be handicapped fairly or unfairly in much the same way.

The imposition of a duty on imported goods may conceivably be a perfectly fair handicap. Our Colonies for example may desire to protect their young manufacturing industries against countries which have acquired special

skill and experience in the lines they wish to develop. From this point of view it may be a perfectly legitimate and fair handicap to impose such a duty as would bring about something like the *equality of opportunity* already referred to ; and, by an equality of opportunity here we mean a fair opportunity to sell the local product in the protected market at a price which shall be approximately equal to the cost of the imported article plus the duty. It then becomes a *competition of quality*, not price.

Even a prohibitive duty may not be necessarily an unfair handicap when dealing with a competitor who plays the game unfairly. The drawing of the colour line, both in sport and industry, is sometimes considered to be an unfair handicap on the coloured races, but it may be considered fair in principle if the coloured races have persistently and deliberately refused to adopt fair methods of competition ; or if they possess inherent qualities, which no ordinary handicap can counterbalance. It may be perfectly legitimate to impose a prohibitive handicap if an opponent possesses inherent qualities which make it impossible to handicap him in a way which shall secure an approximate *equality of opportunity.*

IMPORT DUTIES.

Having thus laid down generally what one may consider to be fair and unfair handicaps, one may proceed to consider whether or not British industry, particularly British export industry, suffers under handicaps which may be considered in any other light than unfair. Leaving home trade on one side for the moment we are faced abroad with a system of protective duties, which, in that they are applied equally to our competitors as to ourselves, may be considered as a perfectly fair handicap. When, however, our competitors, particularly German competitors, have two distinct price lists for goods, one which is used when there is no competition, and the other only where competition is met with a handicap is put on us which, whilst possibly not unfair in itself, becomes unfair when considered in conjunction with method of imposing import duties.

It seems to be unfair when this kind of competition is met with in our Colonies who impose *ad valorem* import duties on the selling price of goods in the Home market, as the German manufacturers are then able to produce invoices for goods sold in certain localities in their own country where competition exists, the prices being as much as 40 to 45 per cent. below the recognised prices in other parts of their own country where price agreements are in force. The Colonial preference given to British manufacturers is a totally inadequate offset to this great difference in invoice prices.

TRANSPORT.

There is, however, no need to look very far afield in order to appreciate the very unfair way in which British export industry is handicapped in competition with foreign export trade. Among the greatest handicaps are those imposed not by our enemies, but by those on whom we should be able to count as allies fighting on the same side as ourselves the battle for the supremacy of British industry. Let us consider, for instance, the excessive rates for transport by rail or sea imposed by British Railway and Shipping Companies. Not only are they, in themselves a heavy handicap when compared with Continental rates, but we are handicapped in a way which is absolutely foreign to all British ideas of fair play in the fact that British shipowners carry foreign goods from British ports to our Colonies at rates far below those charged for British manufactures carried by the same boats.

In most branches of business the large buyer is generally able to purchase more cheaply than is a small buyer, but on British railways there is very little advantage given to the large manufacturer, who transmits thousands of tons per annum, over one who transmits very small quantities. There is perhaps no reason why the man who sends thousands of small packages, each of which requires separate handling, should obtain any preference over one who sends a small number of packages, as the amount of handling, booking and general charges per package may be approximately the same in both cases ; but it is of distinct advantage to the Railway Company to carry a small number of heavy goods rather than a large number of smaller goods, or to carry truck loads of goods from a large manufactory to the dock side than to carry and distribute a small number of packages.

But, except in special cases, the British manufacturer is unable to secure any reduction in the standard rates, no matter what quantity he may send, as there is an arbitrary rate fixed

for carriage from point to point. Nor is there generally any allowance or reduction in rates made for goods marked for export.

This system contrasts very unfavourably with the conditions on the Continent and in America. In America, manufacturers are able to make special terms for large quantities, whilst in Germany and Austria specially low rates are charged on the State Railways for goods intended for export. This applies not only to goods shipped to the sea ports, but also to those transmitted to the frontiers.

The average export railway rate per ton per mile on German State Railways is less than half the British rate, and in some cases is below one-third of a penny per ton per mile.

CANAL AND WATER-BORNE TRAFFIC.

It is well-known that the cost of water-borne is considerably less than rail-borne traffic, a fact much more keenly appreciated on the Continent than in this country. The following figures actually paid by British manufacturers will be sufficient to indicate the great difference in the cost of transit by the two methods :—

- London to Burnley by rail, 43/9 per ton.
- London to Goole by water and thence by rail to Burnley, including transhipment, 21/6 per ton.
- London to Liverpool by rail 31/6 per ton.
- London to Liverpool by water 16/6 per ton.

The reasons for the difference are easily explained, but what it really amounts to is that, as in everything else, we pay for speed, and rail traffic is much quicker than water-borne traffic.

There was at one time a very considerable canal traffic in England, but since most of the principal canals were acquired by the Railway Companies for the purpose of stifling competition, this method of transport has declined. Although there are canals between Wolverhampton and the coal fields, it now costs from 3d. to 6d. per ton more to send coal between these points by canal than by rail, owing to the heavy tolls imposed on the canals by the Railway Companies. It forms a striking commentary on the heavy charges for canal traffic in England that, although there are canals between Wolverhampton and London, German manufacturers can deliver goods in London at a lower cost than can the Wolverhampton manufacturer.

The advantages of water-borne traffic are fully appreciated on the Continent and canal systems are used very largely in Holland, Germany, Austria, France and Belgium. Until a few years ago France with her 7,500 miles of canals and water-ways, upon which over £100,000,000 had been expended, possessed possibly the best system in Europe, although Belgium's 1,300 miles was perhaps the greatest mileage per square mile of territory. By the use of canals Belgian manufacturers could get their raw material from and send their finished goods right up to the docks at the lowest possible cost. In Great Britain there are about 3,500 miles of canals, mostly narrow and shallow, of which at least one-third now belongs to the Railway Companies, whilst Germany alone possesses over 6,000 miles. The canals in Germany and Austria have been specially built to deal with export trade, and large inland harbours have been constructed both at Frankfort and Tetschen which permit the manufacturer to ship goods by canal from Nuremburg, Munich and other South German and Austrian towns. Regular lines of steamers then carry the goods from the inland harbours direct to Hamburg and Rotterdam. The cost of transport on these canals is about half the cost of rail transport, and, as already stated, the average cost of transit by rail for goods marked *export* is about half that on English Railways. The German and Austrian exporter is able therefore to transmit goods by canal at about one quarter the cost of English railway rates. In special cases, say from Dusseldorf to Antwerp and Rotterdam, the cost of transit by water is only from 5d. to 7d. per ton, the distance being 180 miles. This works out to the remarkably low figure of 0·04d. per ton per mile. This is an exceptional rate due to the special circumstance that the barges bring in iron ore for the furnaces as ballast return freight.

The English canals are of course much too small to deal with any great portion of the export traffic, but there is no reason why they should not be developed so that manufacturers would be able to send goods by water at cheap rates, say to Liverpool, the Manchester Ship Canal, Hull and other great ports. This would relieve the railways of much of the slow traffic which causes so much congestion and lowers the average speed of goods traffic generally.

THROUGH RATES.

A very unfair handicap on British export trade is the fact that the importer can get through rates from Continental ports to British inland towns which are very much lower than the British exporter can obtain for outward-bound goods. The following are striking cases bearing on this point :—

Goods shipped from Hamburg *via* Harwich to Bath or Dublin are carried at a lower rate than goods sent from London to these towns. The cost of carriage from Birmingham to Dublin is higher than from Nuremburg or Vienna to Dublin. Among the actual figures given by British engineering manufacturers indicating the unfair advantages which the through rate system imposes on British industry are the following :—

On a certain class of goods shipped from New York to Hull the rate was 22/6d. plus 5% per ton. From Hull to Wakefield the charge was 8/4 per ton, making a total of say 32/-. The through rate from New York to Wakefield was only 25/- plus 5% per ton, showing a saving of approximately 6/- per ton. Such figures as these have given rise to the impression that British Railway Companies favour the foreigner, but as this is illegal it appears unlikely to be the case. It is a little difficult, however, to understand what advantage a shipper gets by sacrificing 6/- per ton in order to deliver goods to an inland town rather than to finish his contract at the port of entry.

Whilst, as mentioned above, these figures give the impression that the British Railway Companies favour the foreign importer it is extremely difficult to obtain any data bearing upon the point. It is, however, a fact that goods imported at Hull for re-shipment at Liverpool are carried between Hull and Liverpool at 15/- per ton, whilst a British manufacturer despatching goods from Hull to Liverpool for shipment will be charged 20/- per ton. No matter how the Railway Companies may seek to justify this differentiation it is a very distinct and unfair handicap on the British exporter.

OCEAN FREIGHTS.

When we compare the oversea freights charged to British and foreign exporters, the unfair handicaps on British industry become even more pronounced. Immediately prior to the war German exporters could send goods to South Africa at rates ranging from £1 to £4, less than British Lines charged to exporters from British ports, and this notwithstanding the fact that German lines were in conference with the English lines and had therefore presumably signed a scrap of paper agreeing to charge the same rates.

Whilst we, in these days, cannot be surprised at anything which a German may do, it tends to make one's blood boil when we find British shippers giving preference to foreigners, particularly to the German exporter. When we find that German goods can be shipped from Hamburg *via* London to our overseas Dominions at considerably lower rates than are charged to British exporters it is high time to raise a strong protest and endeavour to bring the ship owners to book. It will require a great deal of explanation to satisfy a British manufacturer that he is not unfairly handicapped in being charged 62/6 per ton on dynamos and generating plant shipped from London to New Zealand, whilst in the same boat and lying alongside his goods there is German machinery of the same character on which the freight is only 49/-, this figure including freight from Hamburg to London and transhipment into the New Zealand steamer. The following figures of freights to New Zealand are taken from a printed British shipping list dated May, 1914. The figures for the foreign goods include transhipment at the British port.

	From Antwerp, Rotterdam or Hamburg, *via* London to New Zealand.	From London direct to New Zealand.
Dynamos	49/0 ...	62/6
Insulators	32/3 ...	47/6
Glassware	26/3 ...	38/9
Lamp Fittings ...	32/3 ...	47/6

Thus the foreigner paid from 20% to 33% less than the Britisher. The reason, or rather the excuse, given was that it would prevent the Germans running their own ships to New Zealand in competition with British lines. But what was the result ? The Norddeutscher Lloyd boats carried goods to Sydney for transhipment to New Zealand at rates, in some cases, 30% below the British rates for British goods ; and so much trade was diverted to the German line that the Norddeutscher Lloyd opened offices in New Zealand early in 1914 and the first direct steamers were on their way when the war broke out.

Bearing on the same subject is the fact that goods could, before the war, be shipped from New York *via* Liverpool to Sydney at 40/- to 42/- per ton, whilst the freight for British goods sent direct in the same boats as the American, from Liverpool to Sydney, was 45/-. At one time, it may not be the case now, it was very much cheaper to send goods *via* New York to South Africa than from British ports direct to South Africa, notwithstanding the fact that the distance from British ports to Cape Town is 600 miles less than from New York to Cape Town.

REBATES.

The question might not unnaturally be asked: Why do British exporters send their goods by Conference lines of steamers when there are competing lines whose freights are lower? The answer can be given in one word, "rebates." The Conference lines are the *regular* lines, and manufacturers who export goods regularly must perforce use them. On these lines a deferred rebate of 10% is allowed to the shipper on twelve months shipping charges, payable either at the Midsummer or Christmas following the twelve months' operations. This rebate is given conditionally upon the shipper using Conference lines exclusively to those ports to which members of the Shipping Conference run their boats. It is obvious therefore, that even if a shipper could make economies in the cost of freight by occasionally using other lines he would, by doing so, lose 10% on his twelve months' shipping accounts.

Whilst it is not difficult to formulate a complaint it is not quite so easy to suggest a remedy. Royal Commissions have considered the question without suggesting any satisfactory remedy for the evil.

One of the difficulties is the point blank refusal of the Shipping Companies even to discuss the question or to give evidence before the Royal Commissions. The attitude they take up is that their charges cannot be exorbitant in view of the comparatively low dividends which shipping yields.

One might suggest, as a preliminary step towards bringing about an improvement in the existing state of things, that the whole of the manufacturing industries of the country, interested in shipping, should co-operate with a view to effecting some form of co-operation between the manufacturing, railway and shipping industries. It is only by a comprehensive scheme of co-operation that this country can maintain its supremacy among the industrial nations of the world, in competition with its powerful competitors.

THE FUNCTION OF MANUFACTURING AND EXPORT BUSINESS.

What can be done in Export Business? This is a recurring question, and more vital to Great Britain than to most other nations for reasons which are now obvious, so much has been written and expounded upon the subject.

But energy, the fountain of export and of all other business, though inexhaustible, is limited in its daily yield, and most persons now realize the impossibility of totally "capturing German trade." The contradiction in this claptrap phrase is so glaring that one wonders that its use persists. Exchange is the foundation of business, home or foreign. Our ability to engross trade is conditioned by our ability to produce; but our surplus products would be worthless if other nations did not buy them and pay for them with the commodities they produce. Do we mean to say that we wish to buy all those products which Germany has hitherto bought from other nations in exchange for their own? No. We cannot speak so superficially and fallaciously of export business; it is the basic factor in any nation's existence, for it not only supports the nation, but it earns the surplus which gives it power for good or evil in the building of civilization.

It has been said so often that we must persevere in our export trade because otherwise we cannot pay for our imports that many are now asking: How is it we have paid in the past for our imports which have been so long greatly in excess of our exports? How is it we have been able, in addition, to pay the interest on our huge National Debt? How is it we are a rich nation with foreign investments whose dividends help us pay for our luxurious imports? The answer given is that the payments to British shipping companies for carrying nearly 55% of the world's commerce must be added to our

revenue, so that our export trade is, after all, not the only way in which we earn our income.

This reasoning is correct as far as it goes, but it is a half-truth. The export trade is not in itself our only source of income; but by means of it other opportunities have been opened. The shipping business depends primarily on the manufacturing capacity of the country and grew up in response to a need. Shipbuilding was a natural industry in an island country, because means to export and import were necessary; and it goes without saying that the shipping industry would decline if there were no exports to carry from Great Britain. The country would soon lose its *raison d'être* if it should become merely an emporium for re-exports. The bulk of the people are occupied in other activities, some ancillary to shipping. Again, the different industries which are directly auxiliary to the ship-building industry must be maintained by contributing to export trade.

Further, the capital invested abroad, was originally mostly earned, either directly in the industries of this country, or indirectly through shipping.

The importance of industry, then, with all its ramifications at home and abroad, cannot be over-estimated.

For the present, however, most industrialists, occupied by the war and its responsibilities, are content merely "to carry on" as best they can. They intend to win the war, and they mean to win it because they feel they thereby discharge a duty to the world, to their country and to themselves. That issue is clear. But this duty to the world and to Great Britain even to ourselves, can be continuously performed only by maintaining Great Britain so that she may carry on her work in the world. We know what this work is. It is summed up in the words, Liberty, Justice, Integrity.

Every nation must earn its existence in order to exemplify its ideals. We have no vain expectations of "supremacy," commercially nor politically. But Duty, that stern voice, calls us to sustain our endeavours to support Great Britain in her cause. The task must be taken up again where it was left when war orders began to displace foreign orders.

"Preparedness" is the great word in military affairs; it is an equally important consideration for all effective work. Preparedness means knowledge of conditions and readiness to meet them. Statistics of trade as before the war can tell us nothing of the future; they indicate the past. We have to make the future, to build our business anew out of chaos. That all are determined to do, and multitudinous are the various suggestions in regard to details. They may be read in every paper and journal, lay, technical and governmental. Manufacturers are fully aware of the difficulties of export conditions and of possible improvements. If their own experience had not given them this information, it has been abundantly supplied by on-lookers.

Amidst chaotic conditions there remains a seed from the past. From this must grow any schemes to develop future trade. On the foundation of connections and friendships cemented in the past must gradually grow an extended cordiality, strengthened by a recognition by buyers of the worth of British products. We must select our fields of expansion in accordance with past experience, with geographical conditions, and the nature of the goods we can supply; also with due regard to the fact that there are some commercial fields which it is not our function to till. It is not our wish to engage in the trade of cheap and shoddy goods. Extension on the lines in which we have had experience and on which success has previously been achieved will conserve time and energy.

ADVERTISING AND OVERSEAS TRADE. By J. B. BRANSON.

To-day, only one thing matters, to win this war at the earliest possible moment. Every effort must be directed to that end first.

Meanwhile the improvement of British methods of advertising and selling, more especially as affecting overseas trade is the greatest need of the hour in view of the conditions that will follow the war.

Now, this nation is allied with others in a mighty effort to subdue by force of arms the military and naval power of the Central European Empires. Many nations are standing aside, maintaining during this conflict an attitude of watchful and more or less friendly neutrality.

But after the war British commerce will enter upon a contest which, though bloodless, will be no less determined, and will be of much longer duration.

Not only the Central Empires, but nearly, if not quite, all the neutral nations will be opponents.

An immense volume of overseas trade will be strenuously competed for, and during the first decade more especially, the gains will be to those whose advertising and selling methods are most efficient.

Hitherto advertising as applied to engineering and allied manufactures has frequently been of a haphazard and somewhat spasmodic character.

Engineering firms generally have been persuaded that some form of publicity is necessary to their business progress, but in practice the result has almost invariably been unsatisfactory. To remedy this, the advertising policy may need to be recast.

Advertising is an indispensable aid to successful selling. It must be prepared and applied with as much scientific knowledge, and as skilled and practical experience as is required to produce the most intricate and complex product of the workshops or to carry to a successful issue the most closely competitive negotiation of a contract.

First, should come a study of markets. From any and every available source, and, preferably from reports of men sent out for the purpose of preparing them, data should be gathered showing—

(*a*) Number and distribution of population.
(*b*) Occupations and comparative spending capacity.
(*c*) Needs actual and potential.
(*d*) Facilities for transport.
(*e*) Facilities for distributing publicity matter.
(*f*) National characteristics.
(*g*) Any other information that may serve to show favourable or unfavourable factors that may affect an advertising campaign.

Having decided the advertising appropriation necessary, a general plan can now be prepared in skeleton form, showing approximately the amounts to be severally expended on

(*a*) Publicity designed to create goodwill on the part of the prospective purchasing community.
(*b*) More direct advertising of the commodity to the selected class or classes whose need of the goods is most evident, and whose buying power is greatest.
(*c*) Advertising to what may be called the middlemen. Those who will influence the purchases of others and will themselves profit more or less directly by the transaction.

For each of these groups different media and copy will be appropriate.

The media must be selected and the copy written with proper regard to the psychological factors.

Such a vast problem can only be treated cursorily in the space of a magazine article, but at a future date it may be possible to take a specific commodity and indicate the outlines at least of a publicity campaign in some selected country.

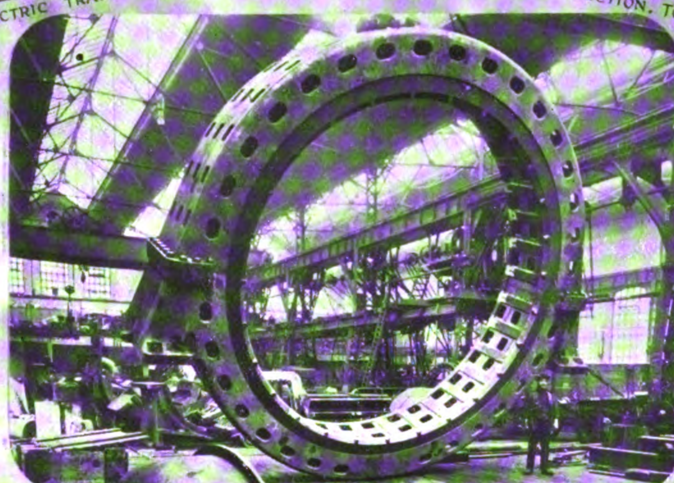
It will be helpful to remember always these few precepts—

(*a*) Address your public in the language most familiar to them.
(*b*) Quote measurements and currency in terms they can easily understand.
(*c*) Give plain and clear descriptions of the commodity advertised, and lucid explanations of its use and value.
(*d*) Remember always that well-chosen illustrations can be read and generally understood by all people whatever their nationality or standard of education.
(*e*) Link all advertisements together by some well-defined trade mark, preferably one that shows the British origin of the goods.
(*f*) Bring personality into the publicity. Machinery is a very material product and in itself carries no human appeal to most minds.
(*g*) Build the advertising with " punch " in it, and be persistent in hammering home the message.

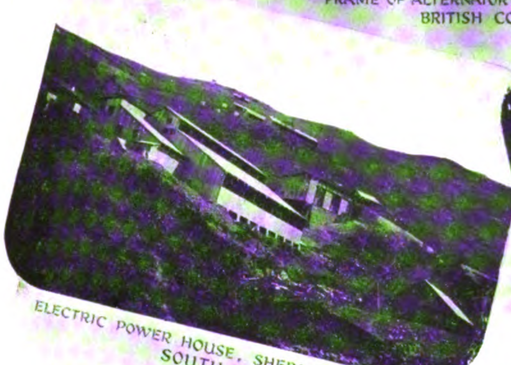
DISTRIBUTION OF BRITISH ELECTRICAL MANUFACTURES THROUGHOUT THE WORLD.

ELECTRIC TRAMWAYS, MANDALAY.

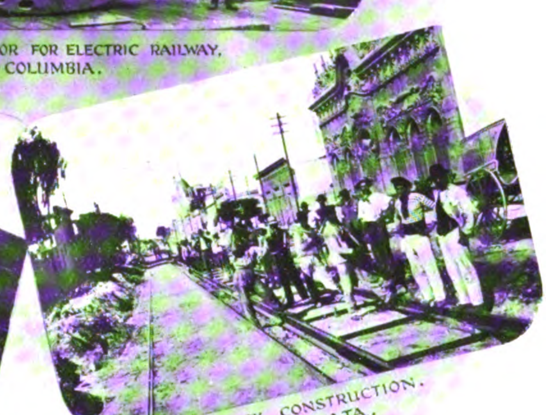
OVERHEAD CONSTRUCTION, TOKYO.



FRAME OF ALTERNATOR FOR ELECTRIC RAILWAY, BRITISH COLUMBIA.



ELECTRIC POWER HOUSE, SHEBA GOLD MINE. SOUTH AFRICA.



TRACK CONSTRUCTION. LA PLATA.

LAYING SERVICES TO MUSEUM NOW USED AS THE
LADY HARDINGE WAR HOSPITAL FOR INDIAN TROOPS, BOMBAY.

PIPE LINE, HYDRO-ELECTRIC POWER SCHEME,
TYSSEFALDENE, NORWAY.

DISTRIBUTION OF BRITISH ELECTRICAL MANUFACTURES THROUGHOUT THE WORLD.

RAILWAY STATION, DURBAN.

HONGKEW, SHANGHAI.

LAYING TELEPHONES NAINI TAL, INDIA.

ELECTRIC CABLES, SEVILLE.

TRAMWAY MAINS. WELLINGTON NEW ZEALAND

LAYING CABLES, ADEN.

POWER FACTOR METERS.

BY R. D. GIFFORD, D.Sc.

The Power Factor Meters now best known may be divided into three distinct classes, *viz.* (1) the Dynamometer type, (2) the Moving Iron type, and (3) the Induction-Dynamometer type.

1. In the dynamometer power-factor meter as constructed for use on three-phase balanced load circuits, the moving pressure system, to which the pointer is attached, consists of a former on which is placed a three-phase winding of fine wire. The inner ends of these windings are starred, and the outer ends are connected through suitable resistances to the three lines, the currents being taken into the coils by means of fine ligaments. The current system consists of two flat coils rigidly attached to the base of the instrument in such a position that the centre of the moving coils coincides with the centre of the current coils, as shown in Fig. 1. The current in one of the three lines traverses the fixed coils, producing an oscillating flux, which, in the usual way, may be regarded as the resultant of two fields rotating in opposite directions. That one which rotates in a direction opposite to that of the field produced by the moving coils has no average effect upon the latter, whilst the other rotating field produces a torque on the moving system proportional to the product of the field strengths and the sine of the angle between their instantaneous positions. The moving system, therefore, rotates until this torque becomes zero—that is, until the rotating field vectors coincide in direction.

If the power-factor of the circuit changes, the vectors will no longer be in line until the moving system has taken up a new position fulfilling this condition. The scale of the instrument can, therefore, be calibrated to indicate the power-factor of the balanced circuit.

It will be observed that it is necessary to use the current of only one line. If the instrument be calibrated for use with phase one current, it would still be accurate with phase two or phase three current, provided the pointer were advanced or retarded 120 deg. with respect to the moving coils.

This instrument constitutes what may be termed a four-unit meter, *i.e.*, three of its coils produce the rotating field and the fourth produces an oscillating field which reacts with the rotating field.

The instrument as described, would not, however, read accurately on an unbalanced circuit, as the reading would obviously depend upon which line is connected to the fixed coil, apart from the setting of the pointer, for the reason that the angles between the currents are no longer 120 deg. It can be shown that if readings are to be obtained which accord with the power-factor of the unbalanced circuit it is essential to take into account the currents in all three lines—that is to say, the meter must have six variables—*viz.*, three pressure and three current coils. Such an instrument constitutes a six-unit meter.

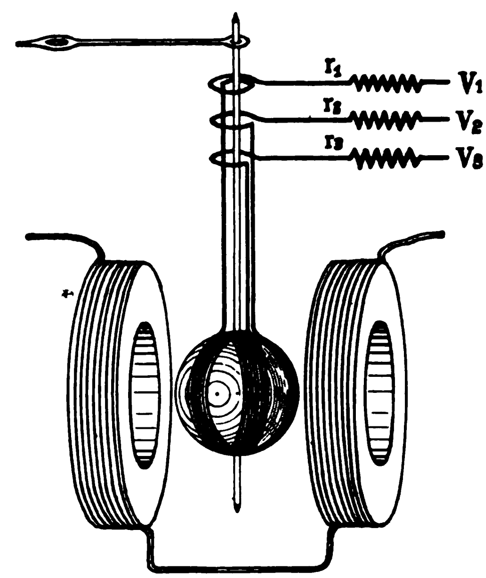


Fig. 1.

Therefore, when constructed for use on unbalanced circuits, the dynamometer power-factor meter has three fixed current coils disposed at 120 deg. to each other, with their common centre coinciding with the centre of the moving coils. They are connected one in each line, and so that the field produced rotates in the same direction as that of the moving system. The pointer then takes up a position under the action of the torque as before.

THE MOVING IRON METER.

2. The moving iron type of phase-meter consists essentially of three fixed current coils, as in the dynamometer type just described, but the moving system takes the form of a soft

iron shaft which passes through the centre of a flat pressure coil fixed within the space enclosed by the three current coils and with its axis normal to the axes of these coils.

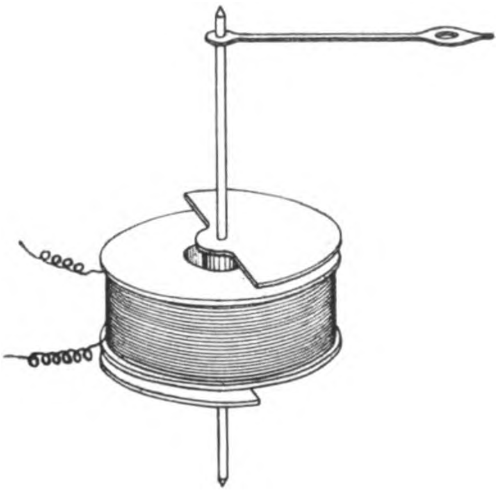


Fig. 2.

Attached to the iron spindle, on opposite sides of the pressure coil, are two semi-circular plates of soft sheet iron which are diametrically opposed to each other, as shown in Fig. 2.

Under the influence of the current in the pressure coil, the iron plates become alternating magnetic poles, and, therefore, react with the rotating field from the fixed coils, taking up stable positions according to the power-factor of the circuit. This is a four-unit meter and does not lend itself to a construction involving six units, as in the dynamometer type for unbalanced loads. It should therefore not be used on unbalanced circuits.

It will be noticed that in this instrument no conducting ligaments are necessary, as there are no currents flowing in the moving system (other than eddy currents). This is a great advantage, as it permits of a complete circular scale divided into four quadrants covering the whole cycle of possible phase angles—*viz.*, 0 deg. to 90 deg. lead, 0 deg. to 90 deg. lag, and similar scales for reversed current.

The chief advantage of the dynamometer type is, as indicated above, its flexibility of construction—*i.e.*, it can readily be adapted for use on single-phase, two-phase or three-phase balanced or unbalanced circuits. The necessary use of conducting ligaments, however, is a disadvantage, for not only do these exert some control on the moving system, although this is unimportant except perhaps at low loads, but they also necessitate a restricted scale, stops having to be provided to prevent free rotation of the pointer, which would result in damaging or breaking the ligaments. This disadvantage is greater than would appear at first sight, for in the unbalanced load meters there are usually nine terminals, six for the three current coils and three for the moving coils, and, therefore, when connecting the meter into the circuit it is a very easy matter to make a mistake, especially as the meters are usually operated through the medium of current and potential transformers, the polarity of whose windings may be doubtful.

In trying to take up its reading the pointer may come into contact with one or other of the stops, in which case, as it is unknown at what part of the scale the pointer would come to rest, the doubt as to the correctness of the connections cannot at once be dispelled.

THE INDUCTION-DYNAMOMETER METER.

3. The induction-dynamometer type of power-factor meter has recently been developed with the object of combining the advantages of complete freedom of the moving system, as in the moving-iron type, with the adaptability of the dynamometer type for use on unbalanced circuits.

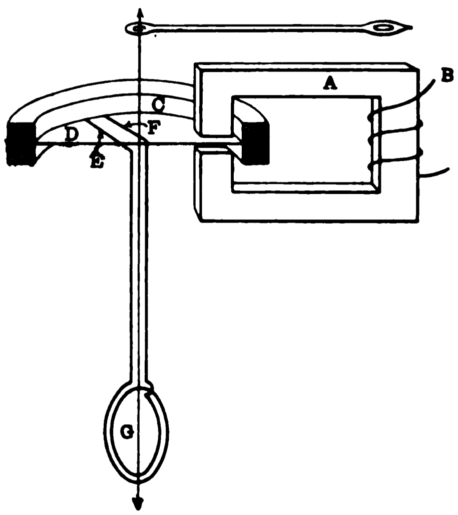


Fig. 3.

This is achieved by the use of fixed coils in combination with a wound motor, as in the dynamometer type, but with this difference—that instead of leading the currents into the moving system by means of ligaments, they are taken in by induction.

The principle is clearly shown in Fig. 3, in which A is a small core of laminated iron having a primary winding B, connected to the external circuit. Attached to the spindle is a circular coil, C, shown in section, supported by

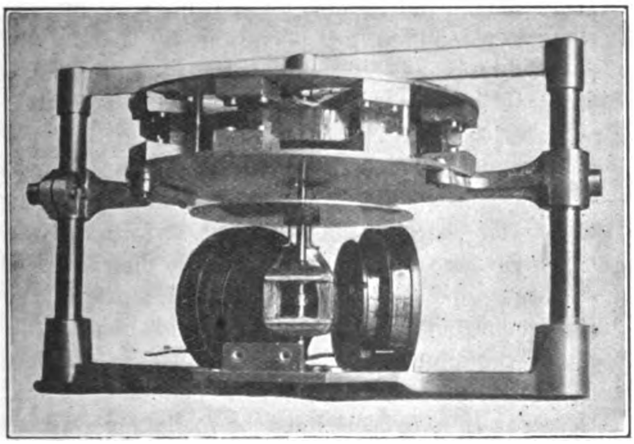


Fig. 4.

a disc of mica D. The coil C constitutes the secondary of the transformer, a narrow air-gap in the core permitting of the free rotational movement of the secondary coil within the magnetic circuit. The ends of the secondary winding are brought out at E and F to a central hub, and are connected to the moving coil G, which also is rigidly attached to the spindle.

It will be seen that owing to the symmetry of the secondary coil, there is no tendency for it to rotate under the action of the magnetic flux from the primary—that is to say, there are no extraneous controlling forces on the moving system.

Other advantages arise incidentally from this system of construction. Reverting to the moving-iron type, the effect of the rotating current flux upon the moving iron is to create, in addition to the ordinary " directive " torque, a considerable " drag " torque, tending to produce a spin. The design is such, however, that the directive torque is much in excess of the drag torque. It will be seen that as the current in the current coils varies, both these torques vary and hence the reading of the instrument is more or less independent of the load.

Now take the case of a low-tension heavy current balanced circuit. No potential transformers are required, but at least two current transformers are necessary to excite the three current coils of the meter.

It would evidently be an advantage to have only one current transformer, using this to excite the moving iron, and to wind the three coils surrounding the latter with pressure windings for direct connection to the lines This, however, is not permissible in the moving iron type, as the steady pressure produces a constant rotational drag on the iron, whereas the directive torque will vary with the magnetization of the iron, *i.e.*, with the load current. The readings of the meter would therefore not be independent of the load.

On the other hand, as there is no appreciable drag produced on the fine wire moving coil of the induction-dynamometer power-factor meter, it is evident that the three fixed coils may be pressure-wound and the small internal transformer may have a primary winding supplied from the secondary of a single current transformer in the main circuit. In this way the expense of one current transformer is avoided.

The induction-dynamometer power-factor meter for use on unbalanced load circuit is provided with three fixed current coils and a three-phase moving coil, the latter being fed from either two or three secondary coils, whose primaries are connected across the supply, either directly (up to 650 volts) or through potential transformers.

In actual practice the internal transformer in the meter does not take the simple form shown in Fig. 3, but is of the multipolar pattern, in which one annular primary coil excites a complete set of poles, attached to circular plates. This is illustrated in Fig. 4, which shows the working parts of a three-phase balanced load meter. This form of construction is economical of space and gives a high ratio of torque to weight of movement. For single-phase circuits the fixed system of the meter consists of four pressure coils, one pair being in series with a choking coil and the other pair in series with a non-inductive resistance. Both pairs of coils are connected across the single-phase lines, a rotating field being produced by the choking coil and resistance, whilst the moving

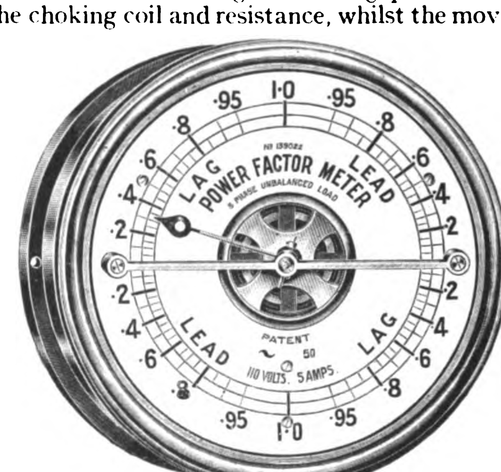


Fig. 5.

coil is supplied from an internal transformer whose primary coil carries the line current.

A view of the complete circular scale obtained on these instruments is shown in Fig. 5.

AUTOMATIC CONTROL GEAR FOR USE WITH ELECTRIC MOTORS IN INDUSTRIAL WORK. By FRANK WALKER.

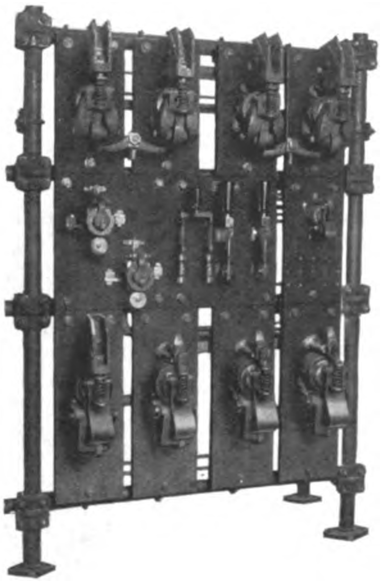


Fig. 1. AUTOMATIC CONTROLLER FOR DIRECT CURRENT REVERSING MOTOR DRIVING LIVE ROLLS.

In previous numbers of the BEAMA JOURNAL, articles describing the chief electrical characteristics and mechanical features of electrical Motors, and of hand-operated control gear for use therewith have appeared.

These articles were written with the object of giving to non-technical readers some assistance in making the best possible selection of Motors and Control Gear, to suit any particular purpose.

In the present article, which should be read as supplementary to those preceding it, a description is given of Automatic Control Gear, of which the last few years have witnessed important developments together with continually extending applications.

By the term "Automatic," as applied to Motor Control Gear, is meant that the functions of control, and of safeguarding the motor, the driven apparatus, the operator, and the system generally, are performed independently of the operator, of whom, in general, nothing beyond the mere operation of a press button or other simple form of master switch is required.

Experience has shown that beyond certain limits, difficulties are experienced with all the various standard types of hand-operated control gear. Thus the contacts of faceplate type starters are not good for large currents, and further, starters of this type are unsuited for services where complicated connections are involved, such as with reversing motors. Drum type controllers are limited in size by the power required for operation by hand; the cost increases rapidly with the size, and provision for overload and no-volt protection must be made separately; moreover above a certain size difficulty is experienced in dissipating the energy of the arc. Multiple lever starters become bulky and also very costly in larger sizes, and are practically incapable of being operated rapidly. Liquid starters also become bulky in the larger sizes and are incapable of rapid operation. Their electrodes (contact plates) must be renewed periodically, and separate provision must be made for overload and no-volt protection.

In some instances, controllers of the above types have been fitted with motors, or otherwise arranged for power operation by electro-magnets or hydraulic or pneumatic pressure; but as will be seen readily the substitution of power for operation by hand only meets one difficulty, and does not overcome the other and more important limitations.

A further difficulty in connection with hand-operated control gear has been the necessity of trusting valuable machinery to the judgment of unskilled operators of varying ability and moods, with consequent damages caused by useless strains incurred at the wrong time and place, often resulting in heavy bills for repairs and still more costly delays, and without any commensurate gain in output.

In their efforts to provide control gear free from the above-mentioned limitations, manufacturers have been aided by the interest and co-operation of designers, users, and operators, and the result of this co-operative effort has been the evolution of automatic control gear to its present state of perfection and very great reliability.

The degree of reliability thus achieved may be illustrated by reference to a certain steel mill, which is driven by two motors. With hand-operated control the armatures had to be replaced approximately every two weeks, frequently requiring new coils and new commutators. About two years ago an automatic controller of the type generally described

below was installed, and since this took place no changes or repairs to the armatures have been required. The successful functioning of this controller will be better appreciated when the duty is considered, *viz.*, to make and break the circuit each time the motors are reversed, which takes place from 150,000 to 200,000 times weekly, with a normal full load current of 300 ampères and peak currents of 700 ampères (as against 1,000 ampères with hand control). So far, the controllers show no sign of wear except on the contacts, which are inexpensive and are constructed specially to allow of simple and quick replacement, and are renewed on individual switches as required after they have operated from one-and-one-half to two million times.

Besides overcoming the difficulties incidental to manually operated control gear, the development of automatic control has brought other benefits. In certain existing applications of the electric drive it has been found possible to use smaller motors and simplified driving arrangements, with not only lower maintenance costs and smaller maximum currents, but at the same time, appreciably reduced consumption of energy and faster operation giving increased output.

Again, in other instances automatic control has greatly simplified the problem of electric drive, and particularly so where motors are required to start or stop according to the pressure in air or water storage vessels; or subject to the motion of travel limiting switches, actuated either by float control or by the motion of hydraulic accumulators, lift cages, cranes, moving parts of machines, etc.

Further, the advent of automatic control gear has made possible the direct application of the electric drive to numerous machines hitherto driven by complicated arrangements of gearing, open and crossed belts, countershafts, belt-shifting gear, and special combinations of wedge-shaped belts with adjustable coned pulleys, etc. In practically all cases such applications have effected an important reduction in the energy required for driving purposes, and at the same time, the driven machines have given a substantially increased output.

Two methods of operating Automatic Control gear are available, *viz.*, by the use of compressed air or by means of electro-magnets. When compressed air is used the valves are controlled electrically, and this arrangement gives a somewhat more positive action than that of magnet switches. On the other hand, the introduction of air-compressing plant brings in another auxiliary to be looked after, besides which compressed air is liable to contain moisture and this may result in the valve parts becoming frozen, with consequent failure in operation.

Automatic Controllers of the magnet switch type consist of a number of special switches and relays as tabulated below, assembled in different combinations depending on the nature of the work to be done :—

Magnet Switches
- Series type.
- Shunt type.
- Back Contact type.

Accelerating Relays.
Field Accelerating Relays.
Overload Protection.
No-voltage Protection.

Master Switches
- Push Button type.
- Handle type.
- Cam-operated type.

Although the various units, as well as the combinations occurring in controllers supplied for similar purposes by different manufacturers vary to some extent in detail, the design of all automatic control gear of the magnet switch type is governed by the same broad general principles, and these principles may be understood readily by a consideration of the typical apparatus described below. Illustrations of typical magnet switches are given in figures 2, 3 and 4, all of the " clapper " type. This form of construction has the merit of great simplicity. Only few parts are required and these can be so strongly built as to be almost indestructible. The rotary motion of the clapper gives perfect freedom of action. The use of a non-corrosive steel bearing pin of large diameter ensures long life of the wearing parts.

The contacts roll against each other in closing, and are firmly pressed together by a stout spring, thus ensuring a contact surface of large area even after considerable wear. In switches larger than about 125 ampères, contact is made and broken between carbon and copper; when the switch is closed, however, the contact is between copper pieces. Flexible copper braids are welded or riveted to the contacts to connect them with the switch terminals, so that

springs and bearings are protected from the current. The contacts cannot stick together and are opened by a strong gravity pull, assisted by the action of the spring, so that a positive quick break is ensured.

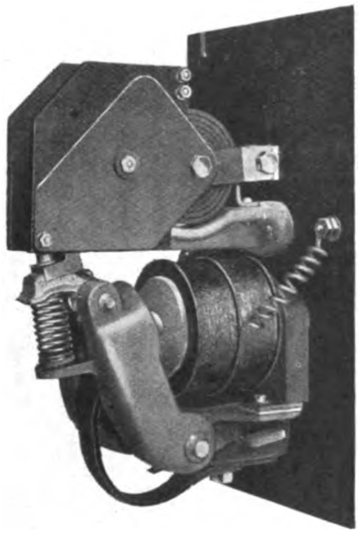


Fig. 2. SHUNT TYPE MAGNET SWITCH, WITH ARC SHIELD AND BLOW-OUT COIL.

Blow-out coils (Fig. 2) are used on all shunt switches but are only required on series switches in special cases. They are connected

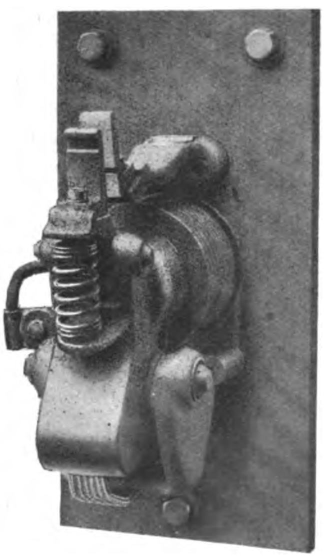


Fig. 3. SERIES "LOCK-OUT" TYPE MAGNET SWITCH.

in series with the fixed contact to which they are attached. By this action the arc is blown away from the arc shields and by being distributed over a large area, is quickly extinguished.

The arc shields (Fig. 2) are made of a compressed asbestos compound, and last a very long time. They are hinged to permit ready inspection of the contacts.

The operating coils are of copper strap wound on edge, or of wire wound on a bobbin, strongly constructed of insulating material. Wire-wound coils are usually covered with a protective wrapping of strong string and by being vacuum impregnated with a special compound are formed into a solid mass, that is impervious to dust and moisture and capable of withstanding high temperatures. The winding is so arranged that both terminals are brought out at the surface, and at no point is there high voltage between turns.

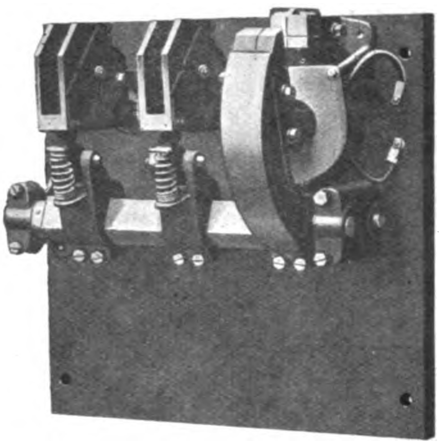


Fig. 4. MAGNET SWITCH FOR ALTERNATING CURRENT.

In magnet switches for alternating currents the operating magnet and the contacts are separate, but are mounted upon a common shaft of square section. Two, three or four pole switches can be supplied with equal facility, two-pole switches being commonly used on three-phase circuits. The magnet core is laminated and has a permanent air gap which prevents magnetic freezing. The stationary pole of the magnet is fitted with a shading coil which reduces the hum in operation to a negligible quantity.

General Features.—Important features of the design of magnet switches are the use of interchangeable wearing parts in shunt and series direct current switches, and in alternating current switches, and the great

ease and quickness with which replacements can be made. The bearing pin is held in place by spring clips and can be removed without the use of tools, after which the moving part, or "clapper," can be lifted clear of all the other parts. The contacts are fixed only by one or two screws. The operating coil may be removed by unfastening its connections and taking out a bolt and in some sizes one or two screws. The arc shield and blow-out coil can be removed with similar ease.

To appreciate the importance of the various features of strength and simplicity in construction described above, it is only necessary to consider the duties that magnet switches are called upon to perform. In simple cases the switches have to make and break the circuit

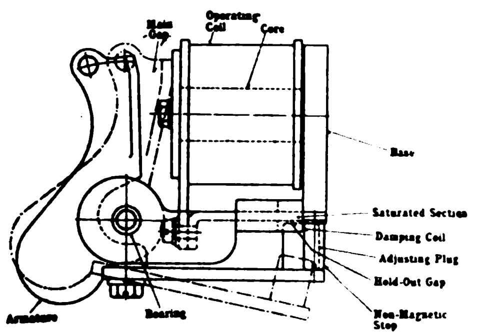


Fig. 5. DIAGRAM OF SERIES "LOCK-OUT" MAGNET SWITCH.

only once or twice in a day, but are required to carry the full load current of the motor continuously, while in more severe cases, when used with a reversing motor that is started, stopped and reversed thousands of times in a day, the switches have repeatedly to open a circuit carrying several times the full load current of the motor, and must essentially be absolutely dependable, regardless of the frequency of operation or the severity of disturbances resulting from abnormal circuit conditions.

Magnet Switches, Shunt type.—Shunt type magnet switches are used for line switches; for reversing; for speed control; and for acceleration where speed control below the full load speed of the motor is required. The operating coil is connected directly across the line, and is energized by a hand-operated switch or by an automatically operated relay, depending on the form of controller.

Magnet Switches Series "Lock-out" type. Series type magnet switches as illustrated in Fig. 3 are used for automatic acceleration without speed control. They are so constituted that the switch remains open so long as the current in the operating coil, which is in series with the motor circuit, exceeds a pre-determined value; as soon as the current falls below this value the switch closes. The principle of operation is as follows:—

Directly current passes through the operating coil a magnetic flux is set up within its core. This flux passes across the main air-gap (Fig. 5) and into the armature, from which the magnetic circuit to the base is completed by two parallel paths, *viz.*, *a*, through the bearings and saturated section, and *b*, through the tail-piece, adjusting plug, and hold-out gap as illustrated.

The path marked "saturated section" is so designed that it becomes saturated with magnetism at the normal current of the motor, and accordingly when the current taken by the motor in starting exceeds this amount, the extra magnetic flux goes through the alternative path, causing the magnetic pull across the hold-out gap to exceed that at the main gap, and to hold or "lock-out" the switch in the open position. As the motor speeds up the armature current and the pull across the hold-out gap decreases, and when this pull becomes less then that across the main gap, the switch closes. To prevent the magnet from closing at the time the flux passes the pull-in point, when building up, a short circuited winding or "damping coil" is placed round the saturated section, so that when the magnet is first energized, practically all the flux passes through the tail piece and across the hold-out gap. The pull across the hold-out gap can be easily regulated by varying the position of the adjusting plug, after which the plug is securely fixed in place by a locking screw.

It will be seen that series switches of the lock-out type combine the functions of accelerating switches and of current limiting relays in one unit. They are used to accelerate motors by cutting out the resistance placed at starting in series with the armature circuit, the number of switches varying according to the number of steps required.

Magnet Switches, Back Contact type.—Magnet switches of the "Back contact" type are used on direct current circuits in controllers where dynamic braking is required (*i.e.*, letting the motor generate current to circulate through a suitable resistance, thus making a braking load for itself). This switch has contacts in both open and closed positions, the moving contacts being mounted on an insulated shaft of square section, and the stationary contacts on the panel above and below the shaft. The switch has two operating coils, a shunt coil above and a series coil for the dynamic braking circuit below. These coils close either the upper or lower contacts, as the case may be, by acting upon an arm mounted on

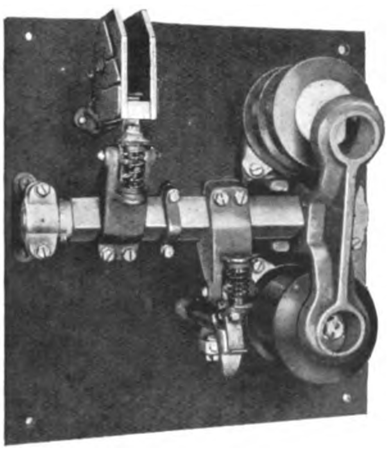


Fig. 6. MAGNET SWITCH, BACK CONTACT TYPE.

the shaft and at right angles to it. The lower contacts are closed by gravity, but at the instant of contact a circuit is established through the lower operating coil, which then holds the contacts positively closed till the current has become sufficiently reduced, or until the circuit is broken.

The "back contact" type of switch allows a dynamic braking circuit to be established in a minimum of time, gives positive interlocking (since it is obviously impossible for the upper and lower contacts to be closed at the same time), and prevents reversal of the motor until dynamic braking has brought it nearly to rest.

The Series Accelerating Relay.—Wherever possible in automatic controllers, series lock-out type switches are used for accelerating by cutting out the starting resistance in suitable steps, since the inherent ability of the lock-out switch to remain open until the current has dropped to a safe value, permits wiring of the very simplest character and does away with accelerating relays.

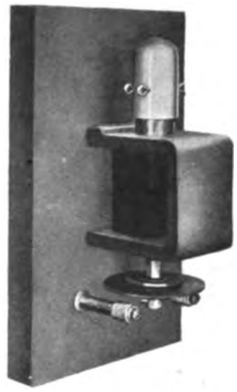


Fig. 7. ACCELERATING RELAY.

In certain applications it is desired to operate at speeds lower than normal, and for this purpose series switches are unsuitable. No difficulty, however, is experienced in meeting this requirement by the use of shunt switches combined with series accelerating relays, a separate relay being used with each switch.

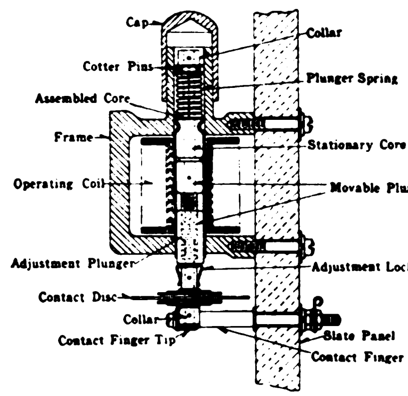


Fig. 8. ACCELERATING RELAY (SECTION).

These relays are mechanically connected to their switches in such a manner that while the switches are in the open position the relays cannot operate. As the switch closes, it depresses the sliding cap at the top of the relay, thus releasing it mechanically, but owing to its operating coil being in series with the contacts of its switch, the relay is held open magnetically so long as the current exceeds a pre-determined value.

When the current falls below this point, the relay closes and energizes the operating coil of the next switch, which immediately operates to cut out a step of the starting resistance, or, in the case of a squirrel cage a.c. motor, connects the motor directly across the line.

Series accelerating relays are used with both direct and alternating current switches, and are alike in principle, although different to some extent in details of construction.

For some purposes it is occasionally desired to effect a change in the motor speed after definite intervals of time, and without reference to the amount of current flowing. In such special cases time limit accelerating relays are used, which are operated by potential coils controlled from the master switch and are equipped with air dash-pots.

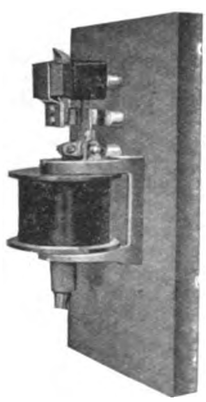


Fig. 9. FIELD ACCELERATING RELAY.

The Field Accelerating Relay.—For use in controllers for direct current variable speed motors a special form of field accelerating or "Fluttering" relay has been devised. This relay is connected in series with the armature, and operates to short-circuit the field resistance whenever the armature current is above normal, as occurs when starting or in the event of a heavy overload when operating. When the armature current falls to a pre-determined point, the relay opens the contacts which short-circuit the field rheostat and allows the motor to speed up towards the point determined by the setting of the rheostat. Should the rush of current be too high, the relay again closes, short-circuiting the rehostat, and continues to operate in this manner until normal conditions obtain.

Hence if the setting of the rheostat is high, the motor is gradually accelerated up to the desired point in a succession of small increments. A magnet is arranged round the contacts to reduce burning and to ensure a quick and certain operation of the relay.

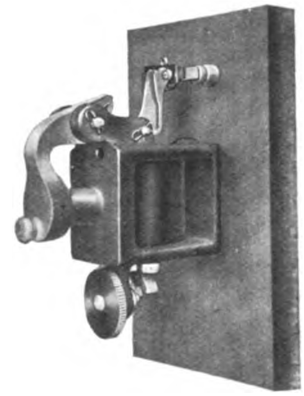


Fig. 10. OVERLOAD RELAY.

Overload Protection.—Protection against overloads is obtained by means of overload relays, used to open a main line shunt magnet switch. A typical relay is shown in Fig. 10, and in cross section in Fig. 11, while two others may be seen in the middle left-hand panel in Fig. 1. The operating coil of the overload relay is connected in series with the motor, and for complete protection two

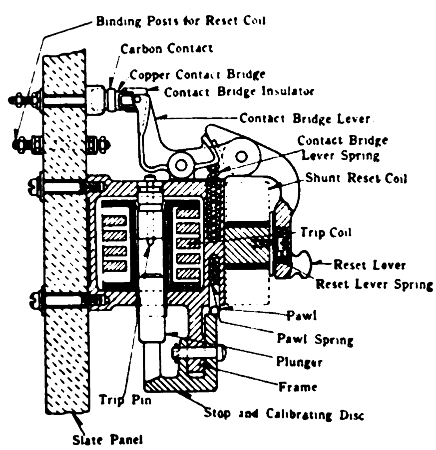


Fig. 11. OVERLOAD RELAY (SECTION).

relays are often used, one in each side of the line. When the current reaches a certain value determined by the setting of the calibrating disc, the plunger rises and strikes the trip pin, which in turn moves the contact bridge lever upwards, thus separating the contacts. At the same time the contact bridge lever is caught by a latch formed on the reset lever, and held with the contacts in the open position. Thus the

control circuit is broken, causing the line magnet switches to open and disconnect the motor from the source of power. Relays of this kind are made in three types for different services—*a*, Shunt reset, which is reset by pressing a conveniently placed push button or bringing the master switch to the off position. *b*, Hand reset, which must be manually closed at the controller. *c*, Automatic reset, which is closed automatically as soon as the overload is removed. In some cases oil dash-pots that require a definite period of time for opening are fitted, a device being included to enable the time period to be varied. The same relay with slight modifications is used for both direct and alternating current.

No volt Release and No-volt Protection. — It is necessary to distinguish between "No-volt release" and "No-volt protection." With no-volt release the motor stops when the supply voltage fails, but on the return of the voltage the starter automatically re-starts the motor. Such starters should not be used except for fans, pumps, blowers and similar services. With starters arranged for no-volt protection the motor stops upon failure of voltage, but on the return of voltage the starter will not operate to start the motor until the operator has pressed a push button or actuated a similar device. Such starters should always be used with motors driving wood-working machinery, machine tools or similar service where danger might be involved, should the motor start automatically upon return of voltage.

No-voltage protection is always given where the control is by push-button, but where the control is by knife switch or similar master switch, to obtain no-volt protection it is necessary to include a device called a Low-voltage Relay. This relay is simply a standard magnet switch of small capacity, provided with a coil so proportioned that the switch will drop out when the voltage falls below a prescribed minimum. The relay operates to open the main control circuit, and will not close on the return of pressure until it is energized from the control device provided specifically for this purpose.

Master Switches.—Master switches are made in a number of types to suit different services, but as the operating currents are only small, master switches used with controllers for the largest motors are small enough to be operated by hand with the greatest ease.

The simplest form of master switch is probably the push. button, which is used both to start and stop a motor, and also, in some cases, to increase or decrease its speed. The more complex forms of master switches employ levers or handles to operate the control contacts; and in cases where several different control circuits must be operated simultaneously, master switches of the drum controller type are used.

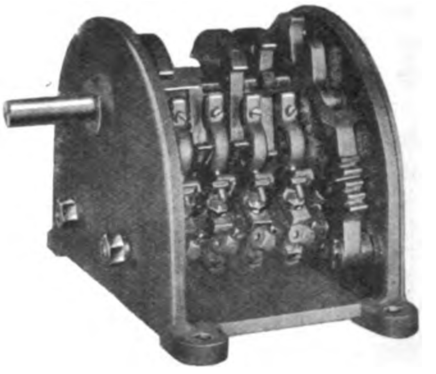


FIG. 12. MASTER SWITCH. CONTROLLER TYPE.

For certain purposes automatic control gear is used to cause a motor to constantly repeat a desired cycle of operations; such as starting, accelerating, slowing down, stopping, and reversal. In such cases special master switches are used, consisting of a shaft geared to the driven machine and bearing a number of cams arranged to open and close suitable operating switches in the required sequence, or alternatively, made on the drum controller principle as illustrated in Fig. 12. The extreme flexibility of both types of construction makes their application to widely differing requirements a simple problem.

Remote Control.—As the operating currents are only small, requiring inexpensive wiring and master switches, the latter can be placed in any convenient position, while the controller itself is placed as near as conveniently possible to the motor. Not only so, but any reasonable number of duplicate master switches can be installed, and the motor controlled from any one of them. This facility is often of great importance in the control of large machines, as it saves the time required for the operator to walk from a remote part of the machine to the controller.

Automatic Operation.—An outstanding feature of automatic control gear is the facility it affords for automatic operation. This feature makes an extremely simple matter of the application of motors to such purposes as driving air compressors or hydraulic accumulators, where the motor must start or stop as the pressure of air or water reaches set limits ; or to motor-driven pumps feeding a tank or emptying a sump, where the motor must start or stop, according to the level of a float ; or, again, for control by means of limit switches attached to hydraulic accumulators. Another purpose for which such limit switches are largely employed is as safety devices in elevators, etc., to bring the motor to rest independently of the operator.

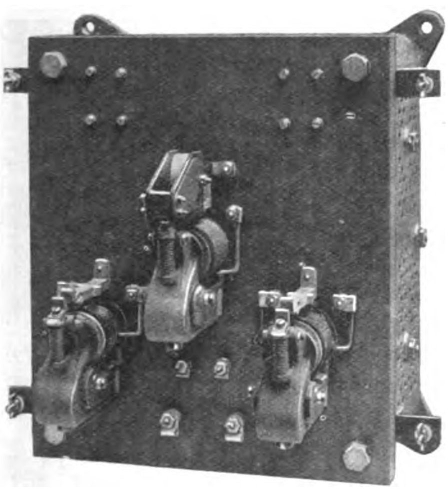


Fig. 13. SIMPLE AUTOMATIC CONTROLLER.

Typical Controllers.—It will be evident that many combinations of the different units that have been described can be made, and it is hardly necessary to say that for the numerous purposes to which automatic control gear has been successfully applied, a large number of widely varying controllers have been built. In the space now available, however, it is only possible to include descriptions of a few typical controllers.

In figure 13 a very simple form of d.c. controller is illustrated, consisting of one shunt switch which closes the line circuit, after which the starting resistance is cut out and the motor accelerated to full speed by two series " lock-out " switches.

In figure 14 a controller for use with a variable speed 50-horse power, 230 volt direct current motor is illustrated. This controller is operated by a master switch having four push buttons marked respectively " start," " speed up," " slow down," and " stop." The controller includes one shunt line switch, three series lock-out switches, an overload relay, a field accelerating relay, and a motor operated field rheostat. On pressing the " start " button, the shunt switch closes the circuit to the motor through all the starting resistance, after which the motor is brought up to its normal speed of 300 r.p.m. quite independently of the operator, by the action of the series lock-out switches.

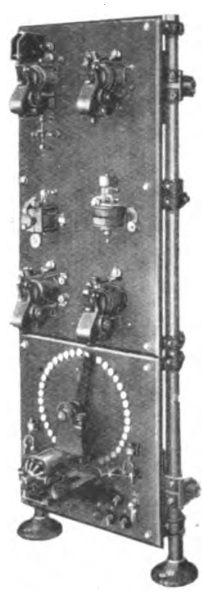


Fig. 14. AUTOMATIC CONTROLLER, WITH FIELD ACCELERATING RELAY AND MOTOR OPERATED FIELD RHEOSTAT.

To accelerate to the maximum speed of 900 r.p.m. the operator presses the " speed-up " button, which causes the rheostat motor to cut out field resistance till the desired speed is reached, when the " speed-up " button must be released. Similarly, by pressing the " slow-down " button, the speed may be reduced, and at any time by pressing the " stop " button the motor can be stopped.

Suppose the motor stopped with the field rheostat in such a position that the speed is, say, 800 r.p.m. It is important to note that on re-starting by simply pressing the " start " button, the motor will be brought up to its normal speed of 300 r.p.m. by the lock-out magnet switches, and subsequently the speed will be increased to 800 r.p.m. in small increments by the field accelerating relay. Similarly, whatever the speed may be before stopping,

the motor will run at the same speed when again put into operation by merely pressing the " start " button.

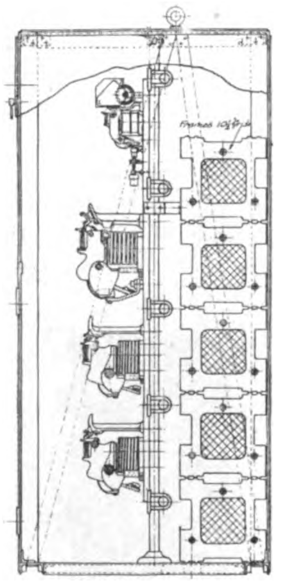


Fig. 15. ELEVATION OF ENCLOSED TYPE AUTOMATIC CONTROLLER.

While it is generally desirable to retain the advantages of ready inspection by installing automatic controllers in positions where they may be left open, no difficulty is experienced

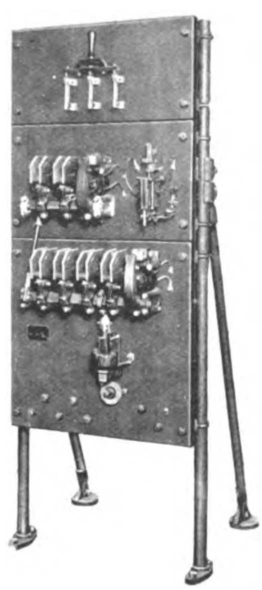


Fig. 16. AUTOMATIC CONTROLLER FOR SQUIRREL CAGE A.C. MOTOR.

in mounting them within protecting covers. Such a controller mounted together with its resistance grids within a sheet iron cubicle is shown in sectional elevation in figure 15. This illustration shows a controller for use with a 200 horse power 220 volt direct current motor driving a pump for feeding hydraulic accumulators, the motors being started or stopped by limit switches actuated by tappets fixed on the accumulators. It is worthy of note that the magnet switches used in this controller have a normal rated capacity of 1,250 amperes.

A typical controller for use with alternating current squirrel cage motors is illustrated in figure 16. In starting, the four-pole magnet switch is closed first, two of the contacts connecting auto-transformers to the line, while the other two contacts connect the motor to the reduced voltage taps on the auto-transformers. One of the starting connections

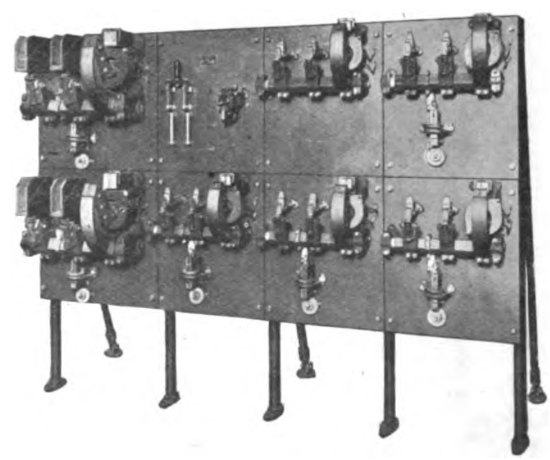


Fig. 17. AUTOMATIC CONTROLLER FOR BOTH STATOR AND ROTOR CIRCUITS OF SLIP-RING A.C. MOTOR.

passes through a current limiting relay which opens a contact circuit and retains this circuit in the open position, until the starting current has been reduced to a pre-determined value. The closing of this contact operates a transfer relay which opens the starting contacts and connects the motor primary to the line wires through the two-pole magnet switch.

A typical controller for use with an alternating current motor of the slip-ring type is illustrated in figure 17. This controller includes a separate switch for the stator circuit, and a number of switches to cut out starting resistance from the rotor circuit, in successive steps until full speed is reached, when all the rotor resistance is short-circuited. Each rotor switch is fitted with a relay that is held open so long as the current through the switch exceeds a prescribed amount, but directly the current

is sufficiently reduced, the relay falls and closes the circuit of the next switch, causing it to close and to cut out a step in the starting resistance.

As the final resistance switch closes, it opens a small auxiliary switch thereby causing all the intermediate rotor magnet switches to open. Consequently under working conditions, the operating current taken is only that of the stator switch and the final rotor switch.

Typical Applications. — Probably the most serviceable way of demonstrating the flexibility and great reliability of up-to-date automatic control gear, will be to enumerate some of the purposes for which it is now in constant use. The most striking testimony perhaps, is that obtained from steel mills and rolling mills generally, where automatic controllers are in constant use with motors driving the main rolls of reversing mills, the screw-down gear, the live rolls, and lift tables for three high mills, etc.

Further convincing evidence is afforded by controllers used with charging machines for coke ovens, and with blast furnace hoists working twenty-four hours daily and seven days a week. Excellent results, again, are reported in connection with mine hoists and elevators of all kinds, where the ease with which the motors can be reduced to a comparatively low speed on approaching the landing platform, proves a great advantage. Great numbers of automatic controllers have been applied to machine tools of all kinds, among which the driving of planing machines calls for special mention. Exhaustive tests made on one electrically driven planer, first with belted drive, and subsequently after the application of automatic reversing control, showed an increase in output of 33 per cent. with a corresponding decrease in the amount of energy consumed.

Another successful application of automatic control coupled with the use of a reversing motor that may be mentioned is to laundry washing machines, which, in some cases, must be reversed as many as seven to nine times a minute.

The advantages of automatic control, and of operation from a number of positions are found to be of great value in the drive of printing presses of all kinds, and particularly so in the case of the large presses used for printing newspapers.

Yet another application that may be mentioned is to calendars for the fabrication of rubber and a specific example may be referred to where, after the introduction of electric drive with automatic control to replace a mechanical drive from a line shaft, it has been found possible to get from three calendars the output formerly obtained from four. In this case 35-h.p. motors were used, and an analysis of all the expenditure shows that the total cost of the electrical equipment was returned in less than two years.

THE ELECTRIC AGE.

"On the morning of Christmas Day, 1821, Faraday called his wife into his laboratory to witness, for the first time in the history of man, the revolution of a magnet around an electrical current. The foundations of electro-magnetics were laid and the edifice was built by Faraday upon this foundation in the fourteen succeeding years. In those years and from those labours, the electro-motor, the motor generator, the electrical utilization of water power, the electric car, electric lighting, the telephone and telegraph, in short, all that is comprised in modern electrical machinery, came actually or potentially into being. The little rotating magnet which Faraday showed his wife was, in fact, the first electric motor.

"Just as Faraday's fundamental researches absorbed his energies for fourteen years after his initial discovery, so the investigators and inventors who have built on these foundations have had to labour for years to gain each new step in advance. Thus the outsider oscillates between a sense of dazed wonder at the miracles that have been worked in so short a time and a feeling almost the opposite—a feeling that with the root of the matter in hand the development might have been expected to be more rapid. But to the man who really knows, neither the swiftness nor the slowness of the process is a mystery.

"In connection with such advances as that of the electrification of steam railroads, still more with such spectacular achievements as those recorded within a few weeks in telephony, both wireless and over the wires, questions of private enterprise as compared with Government ownership and operation naturally suggest themselves. They are not questions that admit of a simple answer, yes or no. But certainly in point of initiative, and of variety and energy of effort, these manifestations of what private enterprise finds itself prompted to do furnish impressive arguments in favour of that side of the case."

MANUFACTURERS' SECTION

BRUCE PEEBLES & CO., LTD.

On the 25th of November last year the inauguration of the NEW ZEALAND GOVERNMENT HYDRO-ELECTRIC SCHEME (Lake Coleridge) took place, the Premier, the Hon. W. F. Massey, switching on the current. This is the first of several Hydro-Electric schemes the New Zealand Government have in hand under the Water Power Act of 1903. It has been carried through by the Public Works Department under the supervision of Mr. Evan Parry, M.I.E.E., and Mr. Lawrence Birks, M.I.E.E., his assistant.

Lake Coleridge, the source of the water power in question, is situated in the South Island in the Province of Canterbury, and is some ten miles long. As this is a scheme of no little magnitude and of considerable interest, Messrs. Bruce Peebles & Co., Ltd., the manufacturers of the electrical machinery, show in Fig. 1, a composite view of the installation which includes: the Power House, exterior and interior, the pipe line, etc., and the motor turbines for driving.

The water turbines for driving the alternators are of the Francis re-action type, while those for the exciter sets are of the Pelton type. The whole of the electrical machinery for this scheme has been manufactured by Bruce Peebles & Co., Ltd., at their Edinburgh Works—the above view showing three Peebles 1,500 K.W. main alternators, 3-phase, 50 cycles, 6,300–6,900

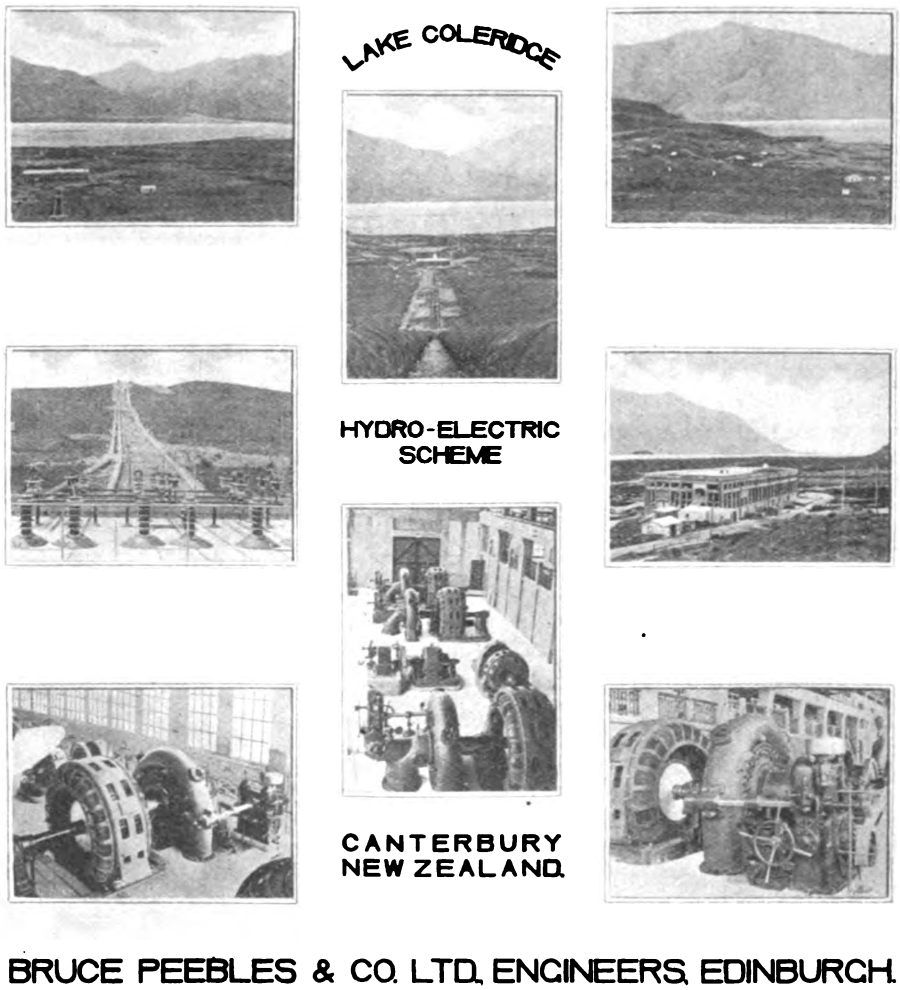


Fig. 1.

volts, 500 r.p.m. The magnet wheels of these machines are specially constructed with dove-tailed pole tips, etc., to withstand runaway speeds. Each alternator has specially long shaft extension and stator racking gear. The alternator fields are separately excited from two Peebles 150 K.W. D.C. generators, also shown in the illustration; one of these is driven by the Pelton wheel already referred to, while the other is driven by a Peebles synchronous motor.

Since the inauguration of this scheme the P.W.D. has received many applications for current, and a fourth 1,500 K.W. alternator, together with another 150 K.W. synchronous motor generator set have been ordered from the makers of the original plant.

The power house is at present arranged for a total of six main generating sets each of 1,500 K.W. capacity (9,000 K.W. total), and three 150 K.W. exciter sets.

The step-up transformers raise the pressure from 6,600 to 66,000 volts and the transmission line from the power house to Christchurch is over seventy miles long; branches are also taken to other districts. Many works are changing over entirely to electric driving and some firms have undertaken the distribution of current on a co operative basis.

THE BRUSH ELECTRICAL ENGINEERING CO., LTD.

The illustration, Fig. 2, shows a three-phase, 50-period transformer, capacity 150 K.V.A., oil-cooled. Primary voltage 6,600, secondary tappings 390, 400, 410 volts.

On test, this transformer showed a no-load loss of 1,040 watts, and the full load efficiency was 98·23 per cent.

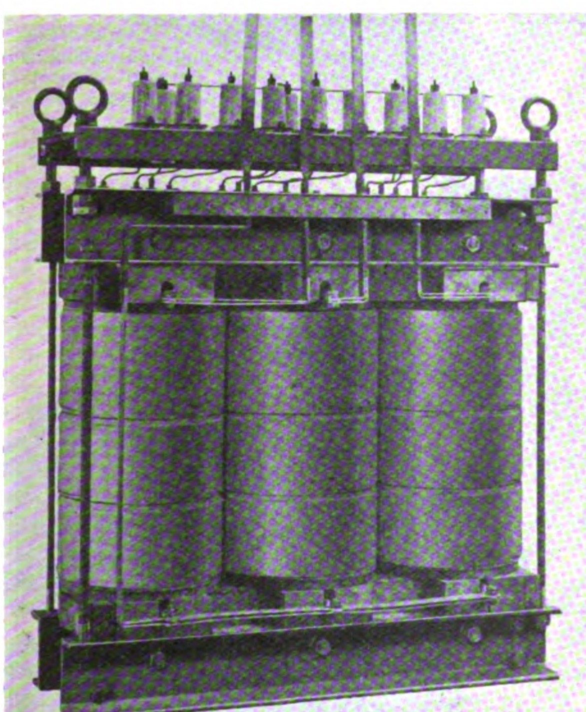


Fig. 2.

The coils are impregnated in vacuum with varnish under pressure, rendering them waterproof and impervious to oil. Clamps are provided for holding the coils in position. The end turns of the windings are specially reinforced to withstand the line voltage between individual turns.

CROMPTON & CO., LTD.

ELECTRIC SUPPLY FOR KARACHI, INDIA.

The latest electric lighting scheme to be completed in India by Messrs. Crompton & Co., Ltd., is at Karachi, on the West Coast, and is of special interest owing to the rapidly increasing importance of this port.

For the past ten years Karachi has had a remarkably flourishing career, owing to the large exports of wheat, oil seed, cotton and other products of the Punjaub, and also on account of the local industries which invariably develop in the neighbourhood of a busy, prosperous seaport with extensive docks.

The prospects of the city as regards the continued increase of trade are very promising, more especially as the Government has already intimated that Karachi will be the Indian terminus of the proposed great Trans-Persian Trunk Railway, linking Europe with India through Moscow and Baku.

In view of the above, and with a population already over 160,000, there is every possibility of a speedy growth of the electric lighting concern, which commenced supply on February 1st, 1915, and in fact considerable extensions to the mains are already being carried out, consequent on an important contract entered into with the Municipality for public lighting.

The photograph, Fig. 3, shows a general view of the Generating Station with the first section of plant which consists of two 240 B.H.P. and one 100 B.H.P. Diesel engines by Messrs. Mirrlees, Bickerton & Day, direct coupled to Crompton Dynamos, which generate at 440/580 volts for a direct current three-wire supply at 220 and 440 volts.

There are two Crompton Patent Automatic Balancers, each capable of dealing with an out-of-balance current of 75 amps., and three motor-driven Boosters, each capable of a continuous output of 150 ampères at 0/115 volts, each booster is separately driven by a motor and takes one side of the system, the third machine being a spare. The balancers and boosters are mounted under the switchboard.

The battery consists of 276 cells having a capacity of 653 ampère hours at the ten-hour rate.

An interesting feature is the special type of battery regulators designed for fixing on the floor above the battery-room and running backwards from the back of the switchboard, operated by means of railway signal type levers in front of the board.

The whole of the distribution is on the overhead system, and consists of bare copper cables carried on steel poles. It has been carried out in strict accordance with the regulations of the Indian Government, and is most substantial throughout, with a considerable margin in the strength of the poles for additions as the undertaking develops. The weight of copper erected in the first section is 35 tons, the whole of which has been treated with an anti-corrosive paint to withstand the action of the salt-laden atmosphere.

It was considered to be of advantage to commence the supply with a continuous current system as tending in the earlier stages to bring the undertaking more quickly to a remunerative stage, but it is not impossible that as the area and the scope of the operations is extended, a mixed system will be adopted to meet the large demand for energy for power purposes that seems sure to grow up.

The station has been built with a temporary end to allow future extensions to be easily made, and at present contains room for another 200 K.W. set. The foundations in themselves were a matter of some magnitude in proportion to the works, as, owing to the nature of the soil, it was necessary to excavate to a considerable depth; the work being also hampered by tidal waters and land floods, but all difficulties were

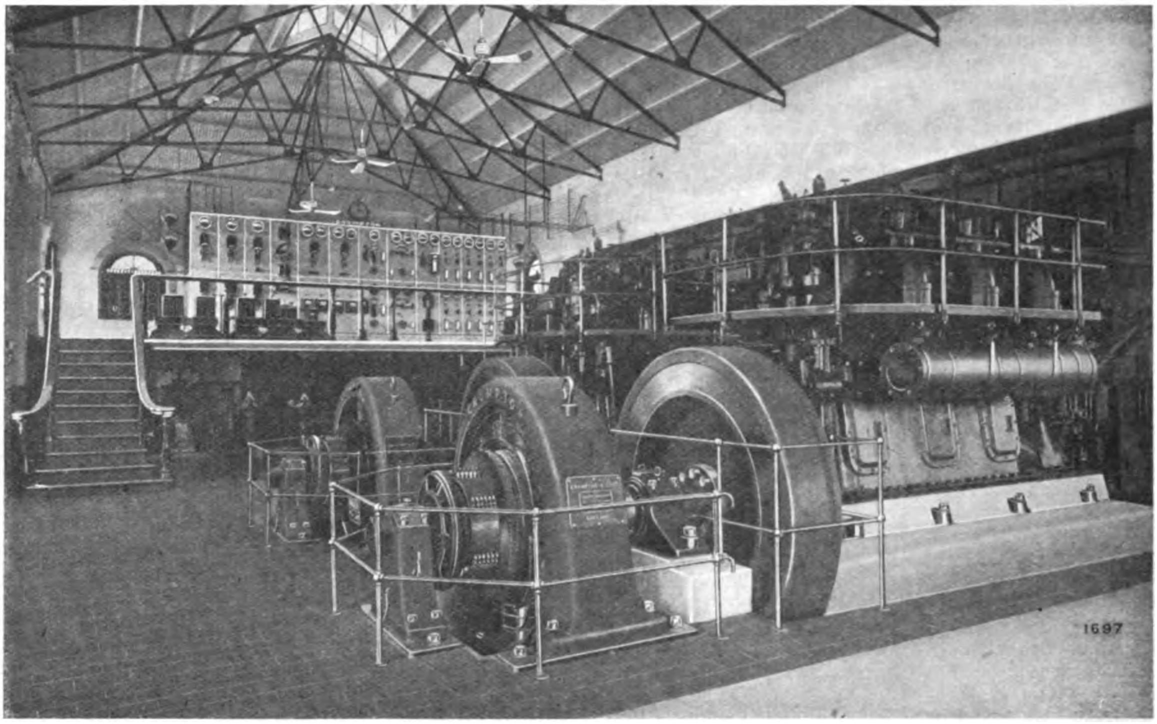


Fig. 3.

eventually overcome, and a substantial reinforced concrete bed laid.

Messrs. Handcock & Dykes, of Victoria Street, acted as consulting engineers for the undertaking, which is controlled by a local company.

Messrs. Crompton & Co. have carried out similar schemes in many parts of the world including several important towns in Australasia. Among their other Indian schemes in operation may be mentioned Calcutta, Cawnpore, Madras, Nagpur and Ahmedabad, and they are now actively engaged on the complete plant and mains for Lucknow and Allahabad, in which there is a total route of mains of about 40 miles.

ELECTROMOTORS, LTD.

Illustrations are given herewith of a range of STEAM DYNAMOS for ship or for general lighting in mills and workshops. The dynamos are of Electromotors, Ltd., standard open protected pattern rated for continuous output at full load. They have one bearing at the commutator end and the dynamo shaft is coupled direct to the fly wheel of the engine. The bearing is of the shipboard pattern with two oil rings so designed as to allow of 15° roll or pitch of the vessel without interference with the lubrication, and all leads are brought out to a substantial terminal box.

The engines are made in three patterns, *viz.* :—Open type; enclosed splash lubrication type; enclosed forced lubrication type. They have ample margin of power and are complete with stop valve, drain cocks and relief valves.

The open-fronted type (Fig. 4) has a central oil box with pipe connections, and in all types the speed can be varied while running by means of governor adjustment. The crank chamber is designed to catch the waste oil which can be drawn off, and both engine and dynamo are mounted on a substantial cast-iron base-plate.

In the splash and forced lubrication types (Fig. 5) a box section engine frame is employed having faced joints throughout, and as will be noticed from the illustration, the glands and governor gear are very

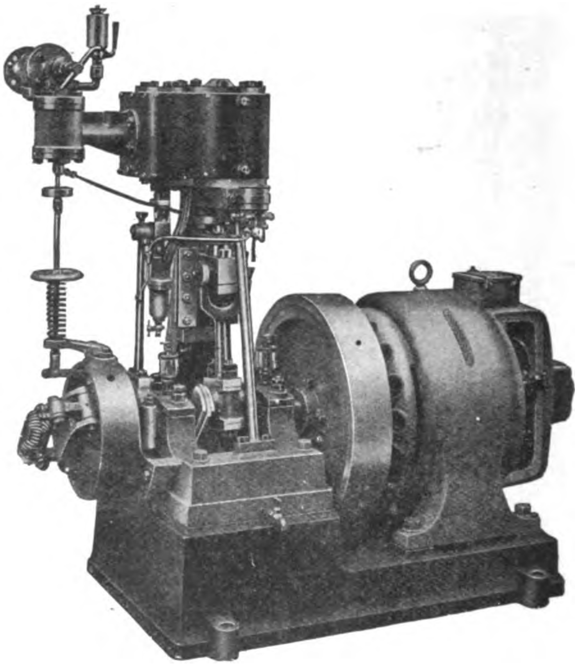


Fig 4.
OPEN TYPE SHIP LIGHTING SET.

accessible. An oscillating pump is fitted in the bed plate of the forced lubrication type feeding oil under pressure to all bearings.

All three types are available for steam pressures between 50 and 200 lbs. to the square inch, condensing or non-condensing, and in sizes varying from below 1 kilowatt to 30 K.W., and arranged for superheated steam when required.

The sets are well built throughout and designed to stand up to the arduous conditions imposed on this class of machinery at sea.

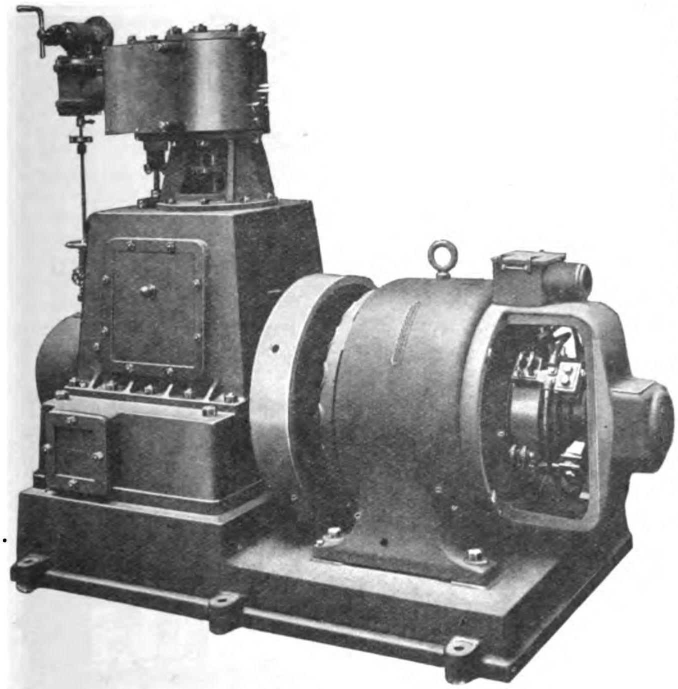


Fig. 5.
SHIP LIGHTING SET WITH CLOSED TYPE ENGINE.

FERRANTI LIMITED.

TRANSFORMERS.

The design of Static Transformers has shown very marked improvement within the last year or two, chiefly in mechanical details.

Messrs. Ferranti Limited have been manufacturing Transformers for upwards of thirty years, but until recently the Company confined their attention to Units not exceeding 100 k.v.a. in size. They are now prepared to quote for any size up to 3,000 k.v.a. and have introduced and patented a number of devices which it is claimed mark a definite advance on past practice. These comprise :—*A Patent Oil Float* ; *A Patent Spring Coil-Clamping Device* ; *A Patent Terminal for use with Tappings.*

The Patent Oil Float is to prevent the sludging of the oil. It is well-known that Transformer Oil, even of good quality, deposits sludge when heated in contact with the atmosphere. To overcome this, several devices have been used to reduce the area of contact surface between the atmosphere and the oil. The device at present under consideration is of this class, but has the following great advantages :—*It occupies very little space. It imposes no pressure on the oil and hence there is no additional tendency for the oil to leak. The provision of the float adds but little to the cost of the Transformer.*

The float consists of a shallow air-tight steel box which rests on the surface of the oil and fits the transformer tank. A leather gasket fixed round the edge of the float makes a sliding joint between the float and the tank and prevents air getting between the float and the oil when its level changes with expansion or contraction due to change of temperature. Figure 6 shows the float in position and Figure 7 the external view of a Transformer fitted with the float. Necessarily, the float must come above the Transformer Terminals. This requires that the terminal bushings must be oil-tight, but no difficulty is experienced in accomplishing this by the use of suitable packing, because the oil is not under pressure.

The Patent Spring Coil Clamping Device is to ensure that between the heavy iron clamps and the end coils sufficient pressure is always maintained to prevent movement of the coils upon the occurrence of short circuits or heavy overloads. Without some such device it is difficult properly to distribute the pressure equally over all the end coils. Moreover, however carefully a coil is dried and however securely fixed it will shrink after some time in service and with ordinary coil clamps it will sustain damage through movement unless the clamps are periodically tightened up. This necessitates shutting down and lifting the transformer from its tank.

The Patent Spring Clamps entirely obviate this.

The device is illustrated by Figure 8 and consists of a pair of metal flanges separated by a number of short compression springs. One or more of these devices are inserted between coil sections, as required. If the coils shrink, the springs expand and maintain the desired pressure.

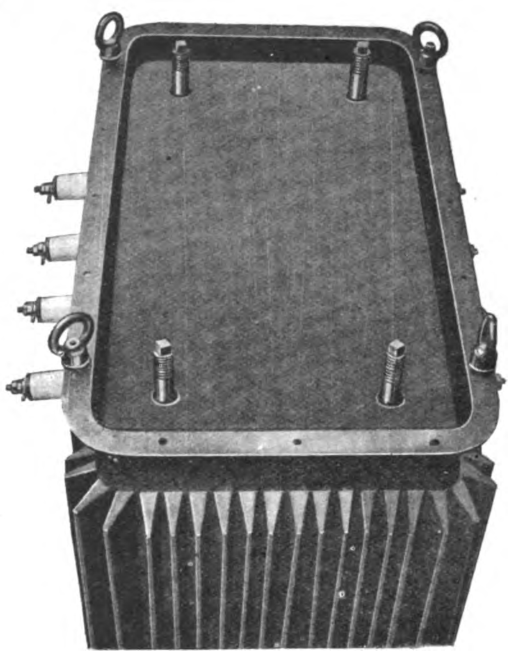


Fig. 6. SHOWING OIL FLOAT IN POSITION.

The Patent Terminal for use with tappings is shown by Figure 9. It consists of a porcelain insulator fitted with a number of terminal bolts arranged in a circle around a central bolt which can be connected to any of the others by a link. One section on each phase is always connected to the line no matter what tapping is in use. This section is specially insulated to withstand sudden voltage rises which are frequently experienced in high-tension work. The special tapping insulators can be mounted on the tank, as shown in

Figure 7 or above the Transformers, as shown in Figure 10.

In addition to the above mentioned devices, great improvements have been made in the construction of the tanks, which are now manufactured entirely at the Firm's Works, Hollinwood, Lancashire.

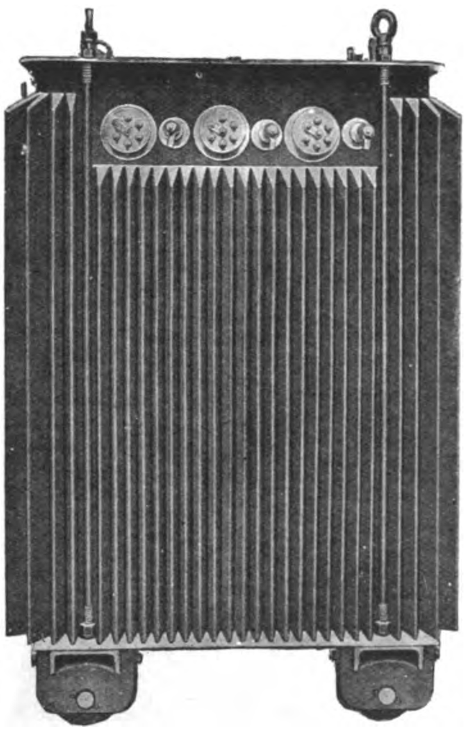


Fig. 7. THREE-PHASE TRANSFORMER WITH EXTERNAL "TAPPING" TERMINALS.

An improved method of making the joints in corrugated sheets has been patented and the tanks are thereby rendered exceptionally strong and absolutely oil-tight. Heavy girders are provided to take the weight of the transformer and all transformers for 150 k.v.a. and upwards are held in position in the

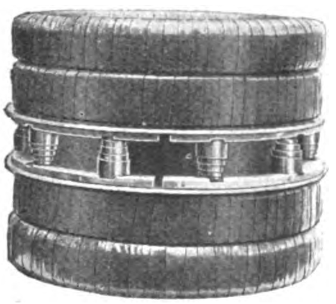


Fig. 8. PATENTED DEVICE FOR TAKING UP COIL SHRINKAGE.

tank by four main bolts. The lower ends of these bolts are screwed into sockets welded into the tank bottom and fixed to the main supporting girders. The upper ends pass through the tank lid and through bars which are clamped under the main eye bolts. These bolts are shown in Figures 10 and 6 and serve also as guides for the oil float.

When thus secured and fitted with oil floats Transformers can be despatched inside the tanks filled with

Fig. 9. SPECIAL PATENTED TERMINAL USED FOR TAPPINGS.

oil. This facilitates installation, reduces the freight charges and obviates "drying out."

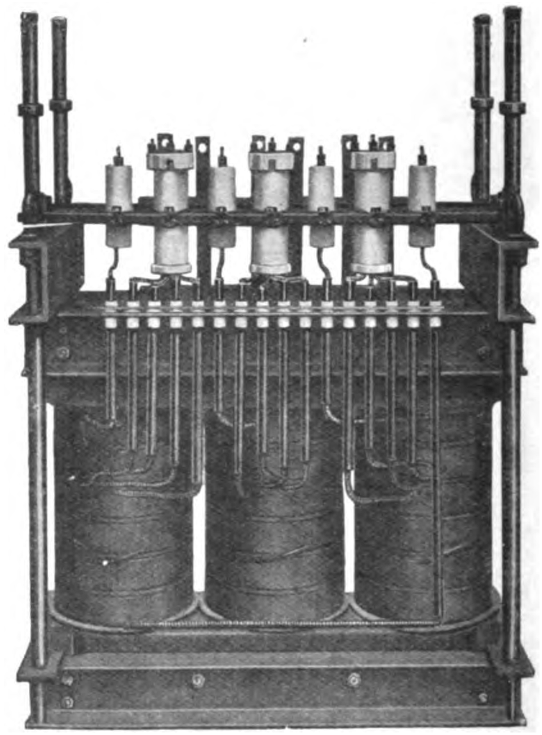


Fig. 10. LARGE THREE-PHASE TRANSFORMER REMOVED FROM TANK.

THE GENERAL ELECTRIC CO., LTD.

ELECTRIC DRIVING IN CEMENT WORKS.

The extensive application of electricity for driving cement works machinery applies to the Overseas Dominions just as much as to this country. A recent installation of electrical plant for this purpose is that of The Adelaide Cement Co., of Adelaide, N.S.W. Gas engines were selected for the prime movers, the installation consisting of two 380 h.p. four-cylinder horizontal gas engines, running at 214 r.p.m., and manufactured

by The Premier Gas Engine Co., Sandiacre, near Nottingham, coupled to 275 k.v.a. "WITTON" alternators, supplied by The British General Electric Co., Ltd., of Sydney, and constructed at Witton, Birmingham, England. The gas producers were manufactured in South Australia by Messrs. Clutterbuck Bros. from designs prepared by their consulting engineer, Mr. W. S. Saunders.

Power is supplied to the works motors at 440 volts, fifty cycles, and the generators are designed for a power factor of 0·725. There are several interesting features about this installation. In the first place, good parallel running has been successfully obtained and the two units run in parallel without the slightest trouble. As is well known, good parallel running is difficult of attainment in gas-driven alternating current plant, unless the engines be well designed and with a low cyclic irregularity. In this connection it is of interest to note that this is said to be the only plant in Australia in which three-phase gas-driven alternators are run in parallel. Not only do the sets run satisfactorily in parallel at no load as well as full load, but they run well when one of the cylinders is cut out.

A second point of interest is the low fuel consumption. On the official tests, the weight of fuel consumed per Board of Trade unit (k.w.-hour) was 1,221 lbs., the fuel used being gas coke. This performance was nearly 25 per cent. better than the guarantee.

With regard to governing, during the official tests full load was thrown off the engines and then switched on again; in both cases the engines showed no appreciable variation of speed.

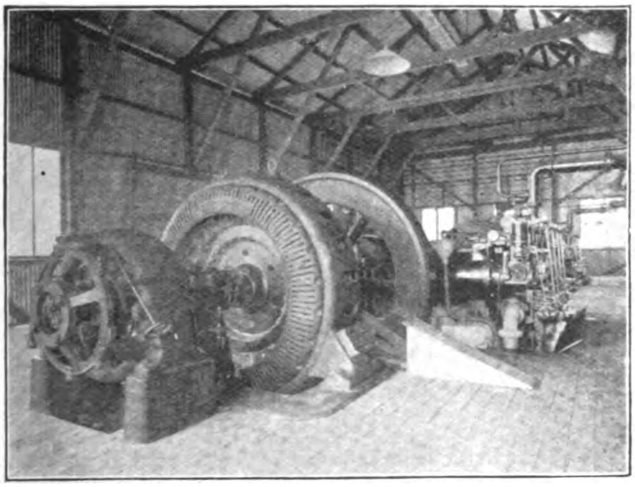


Fig. 11. POWER HOUSE OF THE ADELAIDE CEMENT CO., CONTAINING TWO 275 k.v.a. "PREMIER" GAS ENGINES, DRIVING "WITTON" ALTERNATORS.

The electrical side of the contract was arranged and the plant installed under the supervision of Messrs. Colton, Palmer & Preston, who are the Adelaide agents of The British General Electric Co., Ltd.

MAVOR & COULSON, LTD.

Figure 12 illustrates the generating set and Fig. 13 the switchboard of a plant this firm has shipped to Burmah.

The plant consists of two steam-driven alternators with condensing plant, switchboard, motors with control gear and static transformers for lighting.

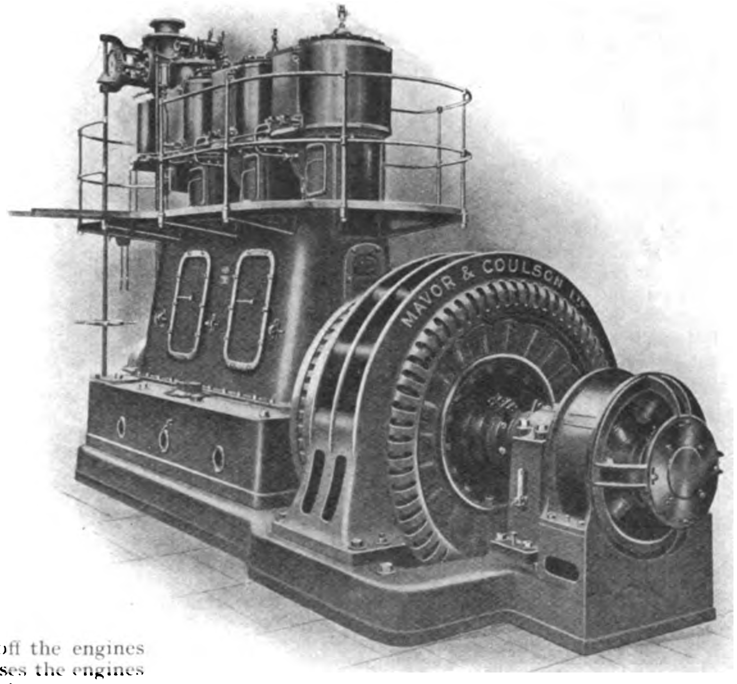


Fig. 12.

GENERATORS. — Each generating set consists of a Belliss & Morcom compound three-crank three-cylinder vertical enclosed double-acting forced lubrication steam engine (120 lbs. steam pressure), driving directly coupled, a Mavor & Coulson three-phase, fifty-period, 625 K.V.A. alternator of the revolving field type, 440 volts, running at a speed of 333 r.p.m. with direct-driven exciter. The engine, alternator and exciter are mounted on a flat continuous bedplate as shown on the illustration.

CONDENSING PLANT. -Each unit is provided with its own surface condenser with the air and circulating pumps separately driven by steam engines.

SWITCHBOARD.—The main switchboard contains two generator, two exciter and one synchronizing, together with two feeder panels, the latter carrying four circuits on each. It is equiped with all necessary switch gear and instruments for the control of the circuits for both power and lighting.

MOTORS.—These are of the Squirrel Cage Induction type, eleven having been provided in five sizes, ranging from 85 to 5-B.H.P., with oil immersed auto-transformer starters for the large, and Star Delta starting switches for the small motors.

TRANSFORMERS.—For lighting, static oil immersed three-phase transformers have been supplied, each having a capacity of 15 K.W.'s, 440 volts on the primary and 110 volts on the secondary. These are placed

at convenient centres in the area to be lighted and feed into a low-pressure system of distribution.

WIRING.—The whole equipment including steel poles with mountings, overhead cables, water-tight distri-

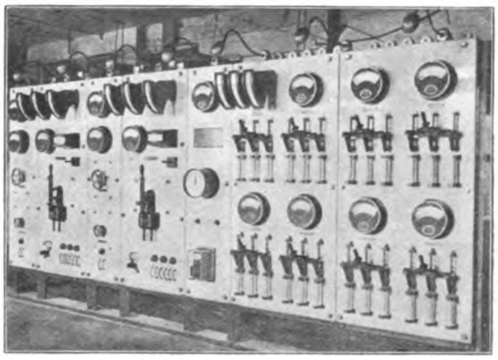


Fig. 13.

bution boxes, branch wiring and other accessories for a complete power and lighting installation have been provided.

NALDER BROS. & THOMPSON.

In all supply systems it is highly desirable that the state of the insulation resistance of the busbars or feeders should be constantly under surveillance.

The following is a description of a LEAKAGE DETECTOR suitable for use on high or low-tension single and polyphase alternating current systems with or without earthed neutrals. The underlying principle is that of superimposing a continuous current on the A C mains. This current is supplied from a battery or other suitable source, one pole being connected to earth, and the other to the system through the detecting instruments and automatic auxiliaries.

Fig. 14 shows the arrangement of the Leakage indicator for a three-phase unearthed system represented at A.B.C.

To one main are connected in series a choking coil, circuit breaker, insulation recorder, leakage current indicating relay and the battery.

The choking coil has a very high impedance and at the same time a comparatively low resistance Its high impedance renders the potential of all the other apparatus connected to it practically zero, the effect

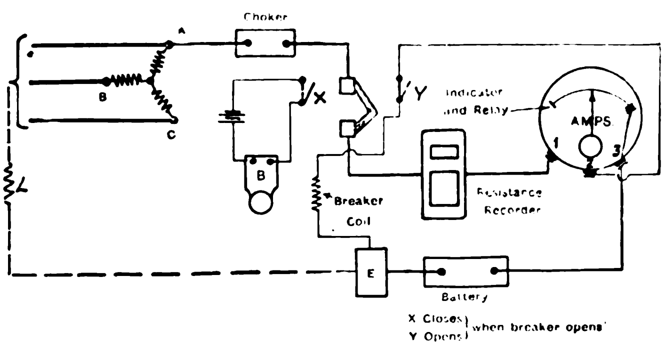


Fig. 14.

being to keep the A C current from the system to earth through the instruments down to a few milliampères. Suppose the insulation of the system becomes impaired as shown at L, a direct current from the battery then finds its way *via* L through the A C system and instruments. The deflection on the recorder, being proportional to this current, is inversely proportional to the resistance of the fault L, as the battery voltage is constant. Thus the recorder gives at all times the total insulation resistance of the system to earth.

Fig. 15 shows an internal view of this instrument, from which it will be seen to be of the permanent magnet type. It therefore responds only to the detecting current from the battery and is unaffected by any

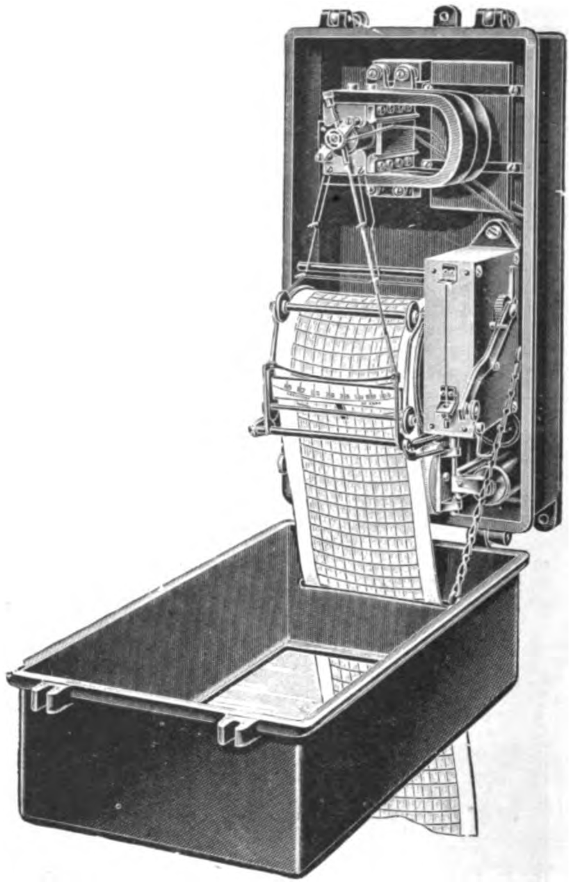


Fig. 15.

alternating current passing through the choking coil to earth. It is necessary for the recorder to be particularly sensitive, as the operating currents are usually very small. To this end, instead of having a pen continually in contact with the chart, as is usually the case, the insulation recorder is provided with a pen which swings freely and is tapped on to the chart, at intervals of about 20 seconds, by means of the tapping bar and coil shown. A supply of ink sufficient for four to six weeks is contained in a trough immediately below the pen, which is fed by capillary attraction.

The scale of the recorder is marked on the side of the trough in kilo-ohms.

The tapping coil is energized by one or two Leclanché cells through contacts periodically made and broken by the main clockwork which drives the chart.

The direct detecting current passes through the indicating relay, which also is a permanent magnet instrument, and is calibrated in ampères.

It will be noticed that the current actually operating this instrument is the detecting current from the

battery, whereas the scale indications are those of the alternating current leaking from main to main.

There are three distinct ways in which the insulation to earth may become impaired :—

(1) Any one line may become faulty.
(2) Any two lines may become faulty.
(3) All three lines may become faulty.

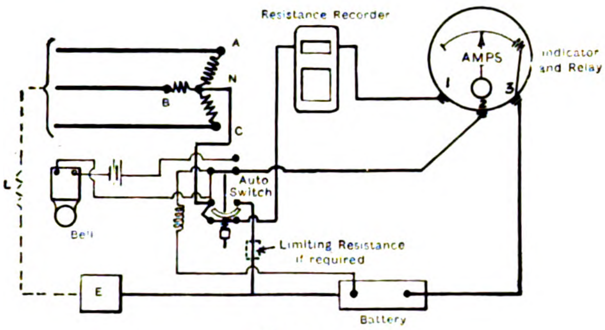


Fig. 16.

It will be seen that for a given insulation resistance recorded, the leakage current will depend upon which of the three above conditions exists on the system.

mined maximum value of the leakage current.

The leakage current terminals of the indicating relay are Nos. 1 and 3 in the figure, the relay terminals being Nos. 2 and 3.

On contact being made by the relay the circuit breaker is thrown across the battery, and in tripping closes the alarm bell circuit at X. At the same time the breaker cuts off the recorder and indicator from the system and also opens its coil at Y. This allows the relay to set itself for future operation.

Fig. 16 shows the apparatus connected to a three-phase system with earthed neutral. In this case no choking coil is required. The apparatus between the neutral point and earth consists of an automatic switch in series with a recorder and indicating relay, as already described.

In operation, if the maximum allowable leakage current is attained, the auto switch is tripped by means of the battery through the relay contacts. The switch then cuts out the instruments and puts the neutral point to earth either direct or through a limiting resistance. At the same time an alarm is given and the relay circuit is broken for automatic resetting.

Fig. 17 shows the apparatus described in connection with Fig. 14.

Fig. 17

Further, if condition (2) be assumed the insulation resistance is made up of the separate faults in parallel, but the leakage current is proportional to those faults in series.

Therefore the different ways in which the faults may occur give rise to a number of possible values of leakage current for a given insulation resistance to earth.

The indicator is, however, calibrated to read the maximum possible value of the leakage current between the mains consistent with the insulation resistance actually being recorded at the moment.

Incorporated with the current indicator is a special type of relay contact set to operate at some predeter-

WILLANS & ROBINSON, LTD.

For some years preceding the outbreak of the present war, this firm took active steps with a view to developing the export side of their business and carried out a considerable number of important contracts abroad.

The firm realized that a primary consideration in the successful operation of modern high-class machinery in distant territories is simplicity of design and facilities in the matter of execution of the necessary repairs and renewals. They have endeavoured to bear these points in mind in preparing the designs for their standard products, the latter point being particularly met by the introduction of a very complete set of jigs and

gauges which ensures interchangeability of parts in the widest sense.

We give below a few examples of some of the more recent steam turbine installations carried out by this firm abroad.

Fig. 18 illustrates one of three 7,000 K.W. steam turbines supplied to the New South Wales Government Railways for their new power station at White Bay, Sydney. Each turbine is direct coupled to a Dick Kerr alternator and exhausts into a Willans vacuum augmentor condenser.

Two similar units have been installed in the Government's older power station at Ultimo, each having a capacity of 5,000 K.W. The same firm have also carried out a large turbine installation for the Sydney Municipality, whose station contains two 2,000 K.W. turbines, three 4,000 K.W. turbines and one 5,000 K.W. set.

The whole of these units drive Dick Kerr alternators and exhaust into surface condensing plants. The condensing plant of the last-named unit which, by the way, has been supplied since the outbreak of the war, is supplied with the makers' latest rotary air pump system, and represents the first installation of this type in Australia.

Amongst other important turbine contracts executed in Australia, we may refer to two 4,000 K.W. sets installed at the Municipal Power Station at Melbourne, two 2,000 K.W. sets supplied to the Adelaide Electric Light & Power Co., and three 3,000 K.W. units supplied to the Western Australian Government for their new power station at Perth.

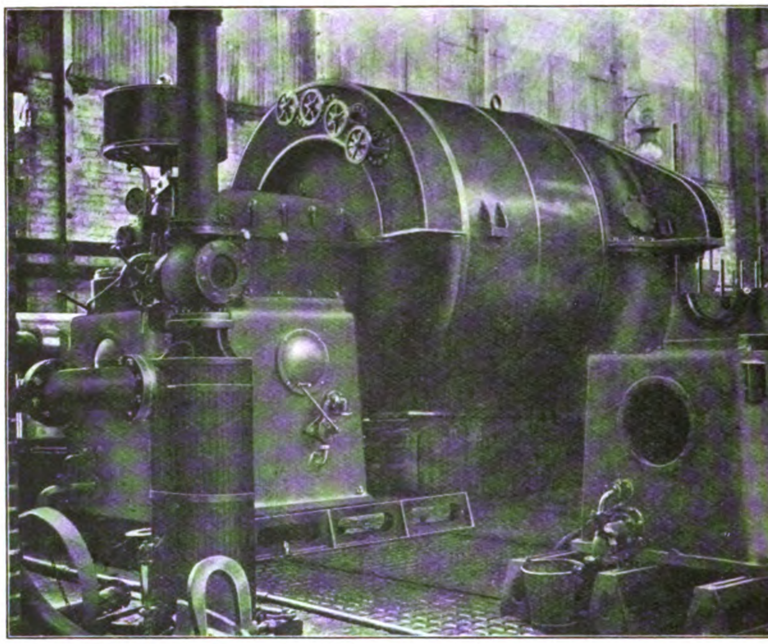


Fig. 18.

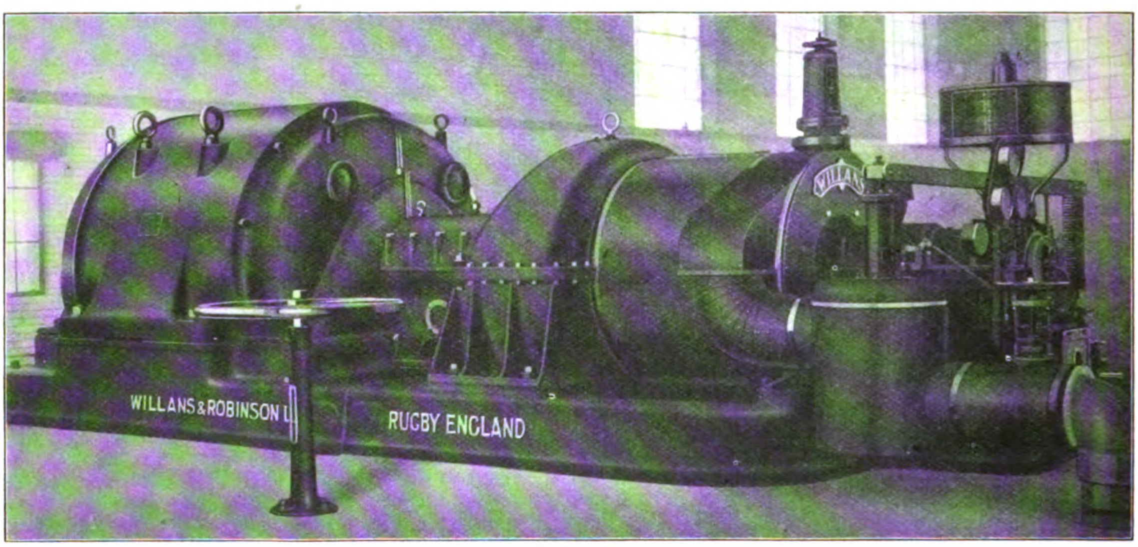


Fig. 19.

Fig. 19 illustrates a 3,000 K.W. turbo generator supplied to the City Electric Power Department at Regina, Sask., Canada. This unit consists of a Willans disc and drum turbine driving a Siemens three-phase alternator and exhausting into a Willans vacuum augmentor surface condensing plant.

The turbo generator runs at a speed of 3,600 r.p.m., and is probably one of the largest units built so far at this speed.

The same power station contains two similar combinations, each of 1,500 K.W. capacity.

Other units supplied in Canada include a 2,000 K.W. turbo alternator set similar to the above, supplied to the city of Edmonton, as well as a 4,000 K.W. unit running at 1,800 r.p.m. installed in the same station.

This Company have also supplied many turbine sets to South Africa, India, Japan and other territories.

NOTICE

The Advertisements in this Journal are arranged in alphabetical order, according to the Name of the Firm.

ARON
CLOCK TYPE METER

FOR ALL PURPOSES C.C. & A.C.

CERTIFICATE
— OF —
EXAMINATION
OF
Watthour Meter No. C.4802. № 21251.

Makers: The Aron Electricity Meter, Ltd.
Type: Oscillating Pendulum. Unshunted.
Range: 1,000 amperes, 550 volts. Continuous Current.

The meter has been tested at various loads over a pressure range of from 500 to 550 volts.

Temperature Coefficient.

Tests were made at an external air temperature of both 15° C. and 30° C. From the results given below it will be seen that the two sets of readings are in close agreement, the difference between them being not greater than is found between two readings of the meter taken under exactly similar conditions. The Temperature Coefficient, therefore, is negligible for the normal range of temperature variation.

	Meter error per cent.	
Load.	At 30° C.	At 15° C.
1	+1.2	+1.2
½	+0.6	+0.2
¼	+0.4	+0.2
$\frac{1}{10}$	−0.2	

Date: October 13th, 1915.
Reference: E.T.D. 108. 29.

J. A. Harker
for the Director

ACCURATE AS A CLOCK.

UNAFFECTED BY STRAY FIELDS.

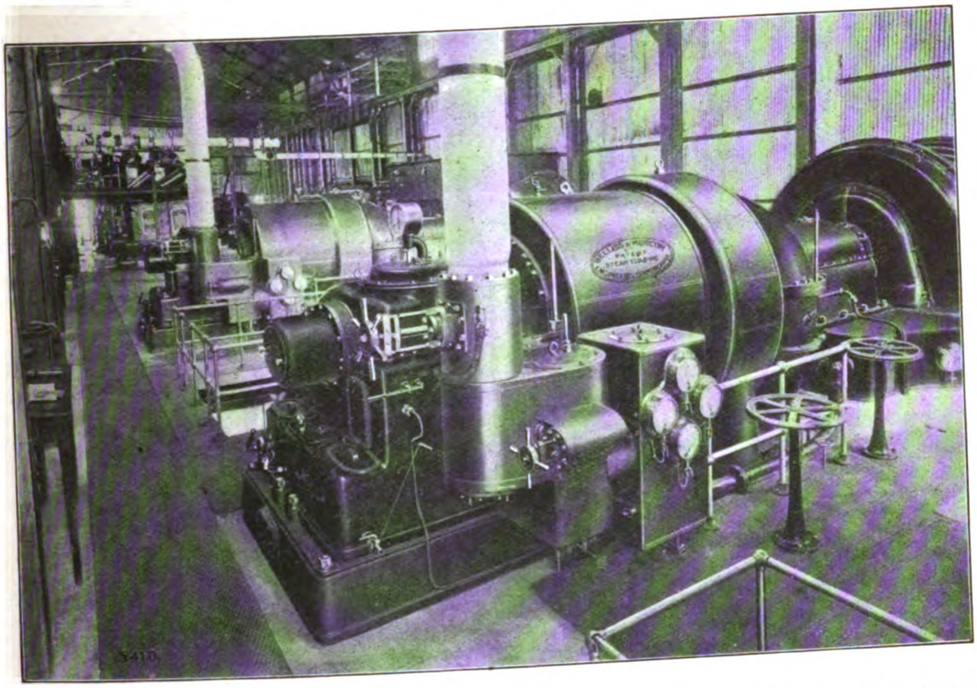
Whole Current Type.

TEMPERATURE CO-EFFICIENT
"NEGLIGIBLE"

MANUFACTURED BY—

ARON ELECTRICITY METER, LTD.,
Head Offices and Works - - - - 80a, Salusbury Road, Kilburn, London, N.W.

"BELLISS" INSTALLATION SETS



THIS photograph shows TWO of three 3,000 K.W. TURBO-GENERATOR SETS (comprising Steam Turbine, Generator and Condenser), installed by BELLISS & MORCOM, LTD., at JOHANNESBURG, SOUTH AFRICA.

"BELLISS" ENGINES for Power, Traction, Mining and Lighting work have been installed or are in hand in almost every centre of industry throughout the world.

On account of their permanent reliability, high-service efficiency, long life and enduring qualities, "BELLISS" ENGINES are the most economical of their kind.

We manufacture **STEAM ENGINES, STEAM TURBINES, AIR AND GAS COMPRESSORS, CONDENSING PLANTS, PARAFFIN AND CRUDE OIL ENGINES (Diesel Type), AND PLANT FOR ALL POWER AND LIGHTING PURPOSES.**

Write for our Catalogue giving full particulars and specifications . . .

BELLISS & MORCOM, Ltd.

Established 1852.

BIRMINGHAM, ... ENGLAND.

London Offices: 8, Victoria Street, S.W.

Telegrams:—"Belliss, Birmingham."

A FULL STOP

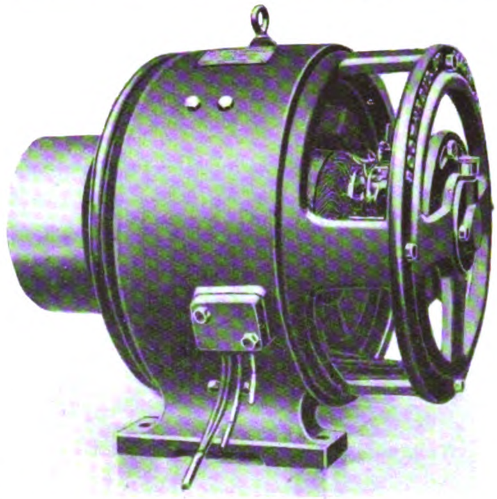
NOW THAT YOUR ATTENTION IS

ARRESTED

Write at once for Prices and Particulars of

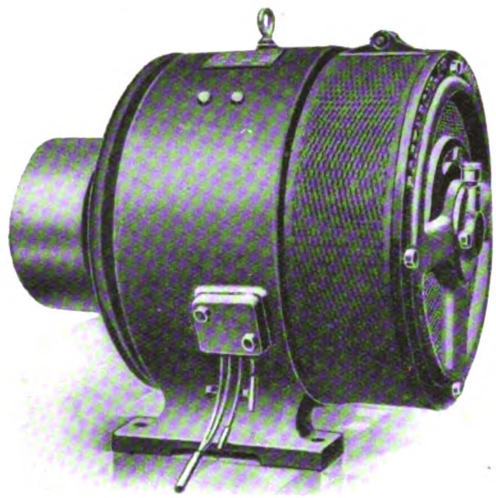
BOOTHROYD

DYNAMOS & MOTORS.



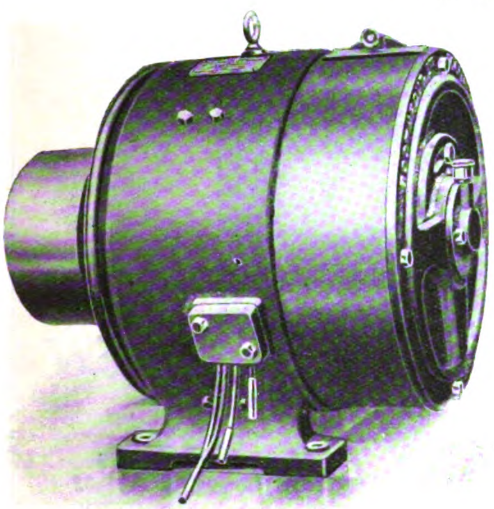
Open Protected Type.

UP-TO-DATE DESIGN EMBODYING ALL LATEST IMPROVEMENTS.



Enclosed Ventilated Type.

ILLUSTRATIONS OF OUR "B" TYPE MACHINES FITTED WITH BALL BEARINGS.

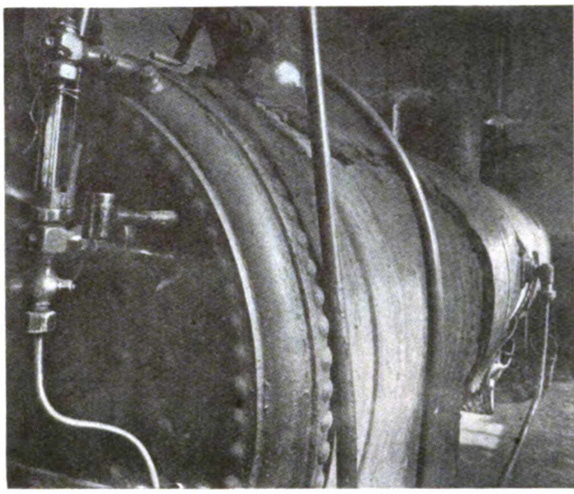


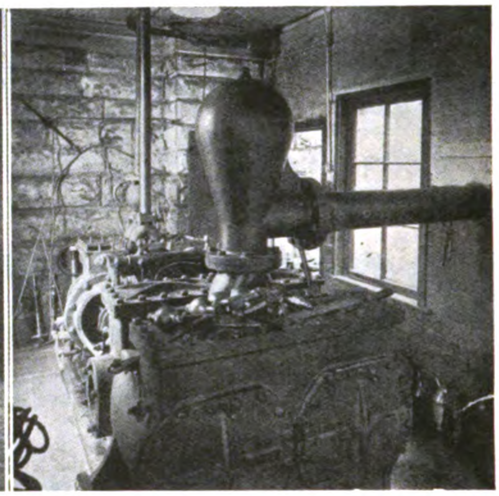
Totally Enclosed Type.

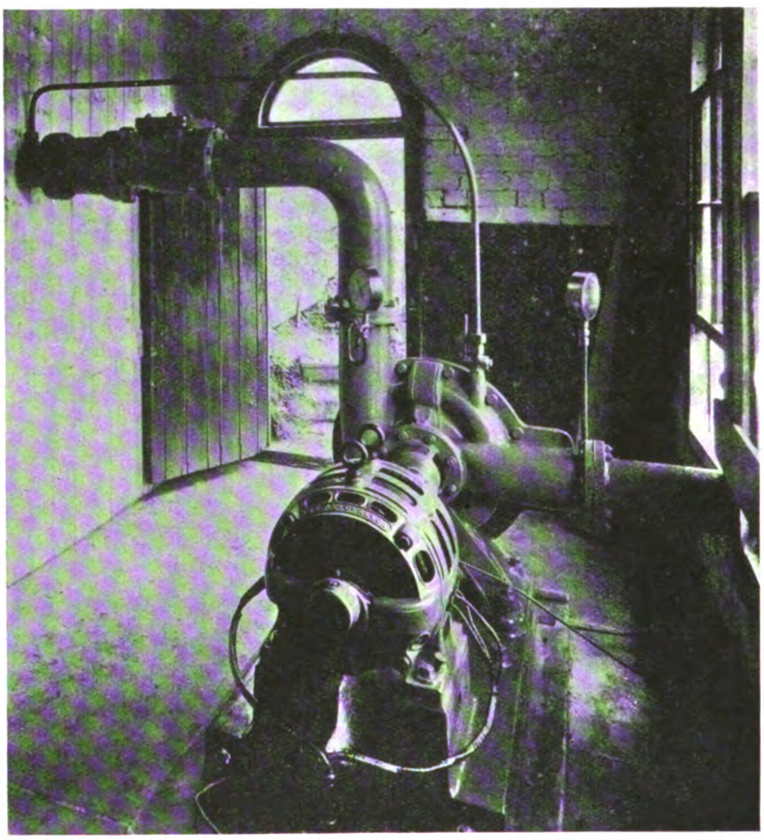
H. T. BOOTHROYD, LTD.,

BOOTLE, - LIVERPOOL.

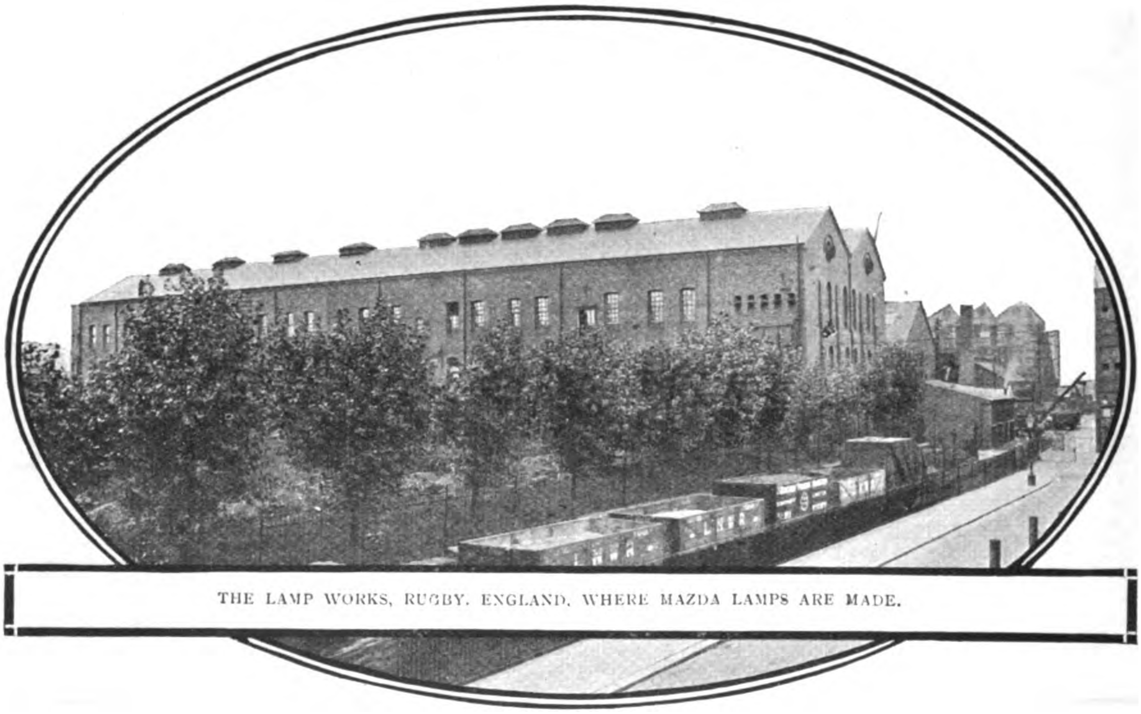
Telegrams: "COMMUTATOR, LIVERPOOL."
Telephone: 420 BOOTLE.







The Three Photographs show an abandoned Steam Pumping Plant at Carlisle and the neat Electrically-driven Centrifugal Pumping Equipment that has taken up the load. The New Pumping Plant is by the



THE LAMP WORKS, RUGBY, ENGLAND, WHERE MAZDA LAMPS ARE MADE.

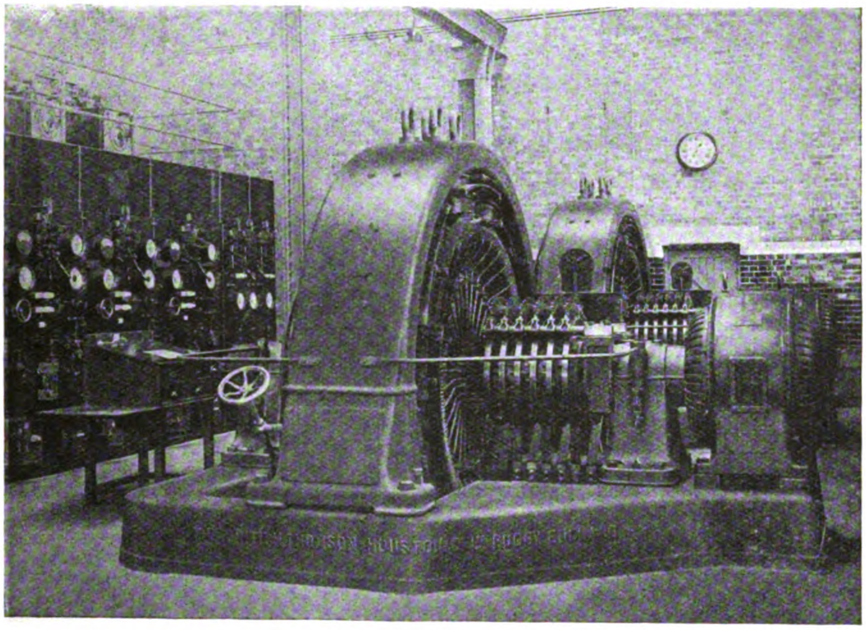
The British Thomson-Houston Co., Ltd.

Less than 30% of full load current is required to start

Self-Synchronising Rotary Converters

(Induction Motor Started.)

while the operation of starting up is reduced to the simplest possible form.



Two 1500 K.W., B.T.H. Induction Motor Started Rotary Converters in a Railway Sub-Station.

On closing the motor switch, the set runs up to and into synchronism when the motor may be short-circuited and the set paralleled on the continuous current bus bars.

Further advantages of these machines are:—

- The converter always builds up with correct polarity.
- There is no sparking at the commutator.
- The set is ready for paralleling on the C.C. bus bars within one minute after closing the motor switch.
- The induction motor can be used to drive the armature of the rotary converter at full speed for the purpose of grinding the commutator or sliprings.

The British Thomson-Houston Co., Ltd.

Electrical Engineers and Manufacturers. **Head Office & Works: Rugby, England.**

Foreign Representatives:

ARGENTINA.—Cia. General Electric Sudamericana Inc., Buenos Ayres.

AUSTRALIA.—Australian General Electric Co., Melbourne and Sydney; Unbehaun & Johnstone, Adelaide; Engineering Supply Co., Ltd., Brisbane; Chas. Atkins & Co., Ltd., Perth.

BRAZIL.—Cia. General Electric do Brazil, Rio de Janeiro.

CHILI.—The International Machinery Co., Santiago.

CHINA.—Andersen, Meyer & Co., Ltd., Shanghai.

COLOMBIA.—Wesselhoeft & Wisner, Barranquilla.

CUBA.—Zaldo & Martinez, Havana.

INDIA.—The British Thomson-Houston Co., Ltd., Calcutta; Turner, Hoare & Co., Bombay.

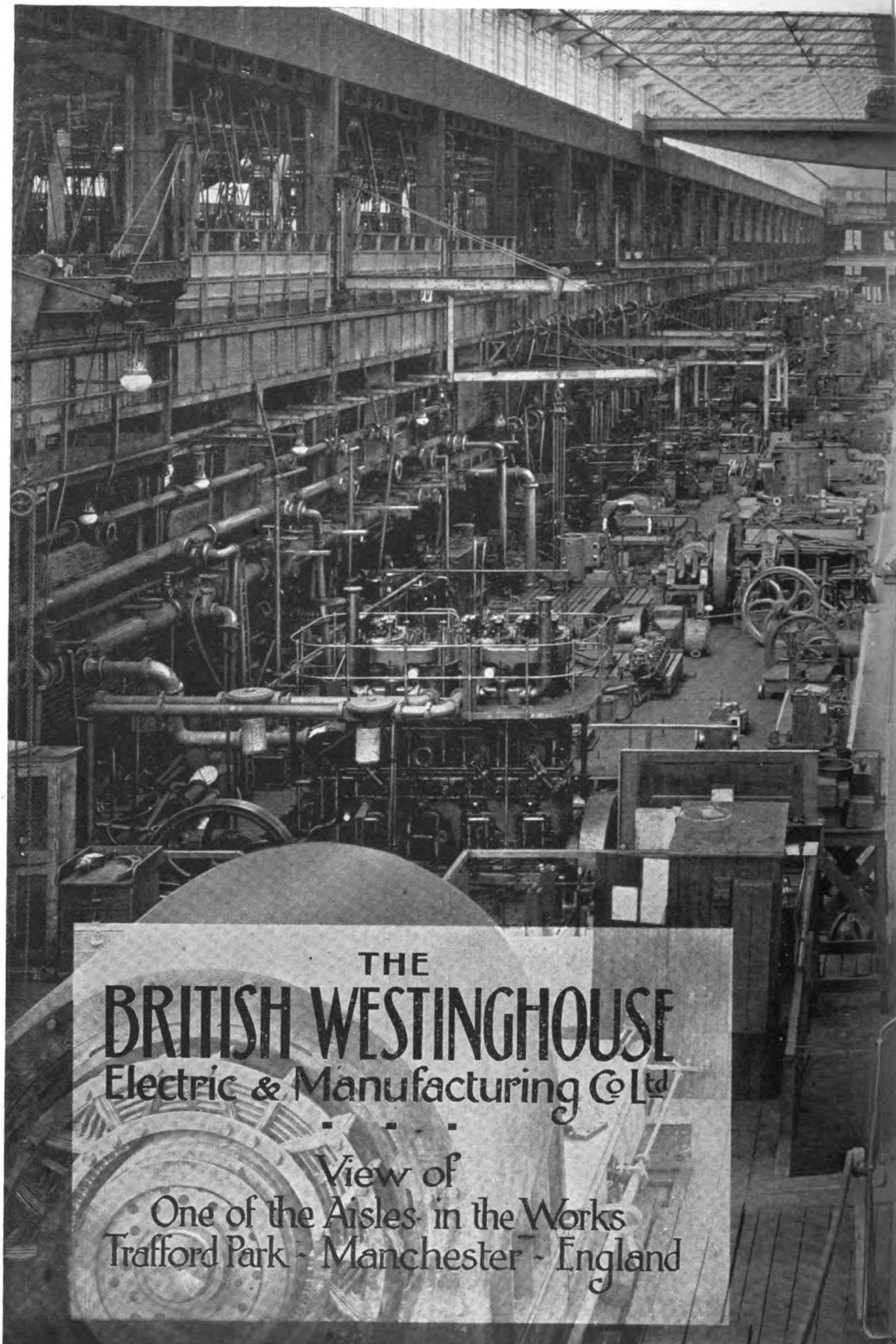
JAPAN.—The British Thomson-Houston Co., Ltd., Yokohama; Bagnall & Hilles, Yokohama; Mitsui & Co., Tokyo and Osaka.

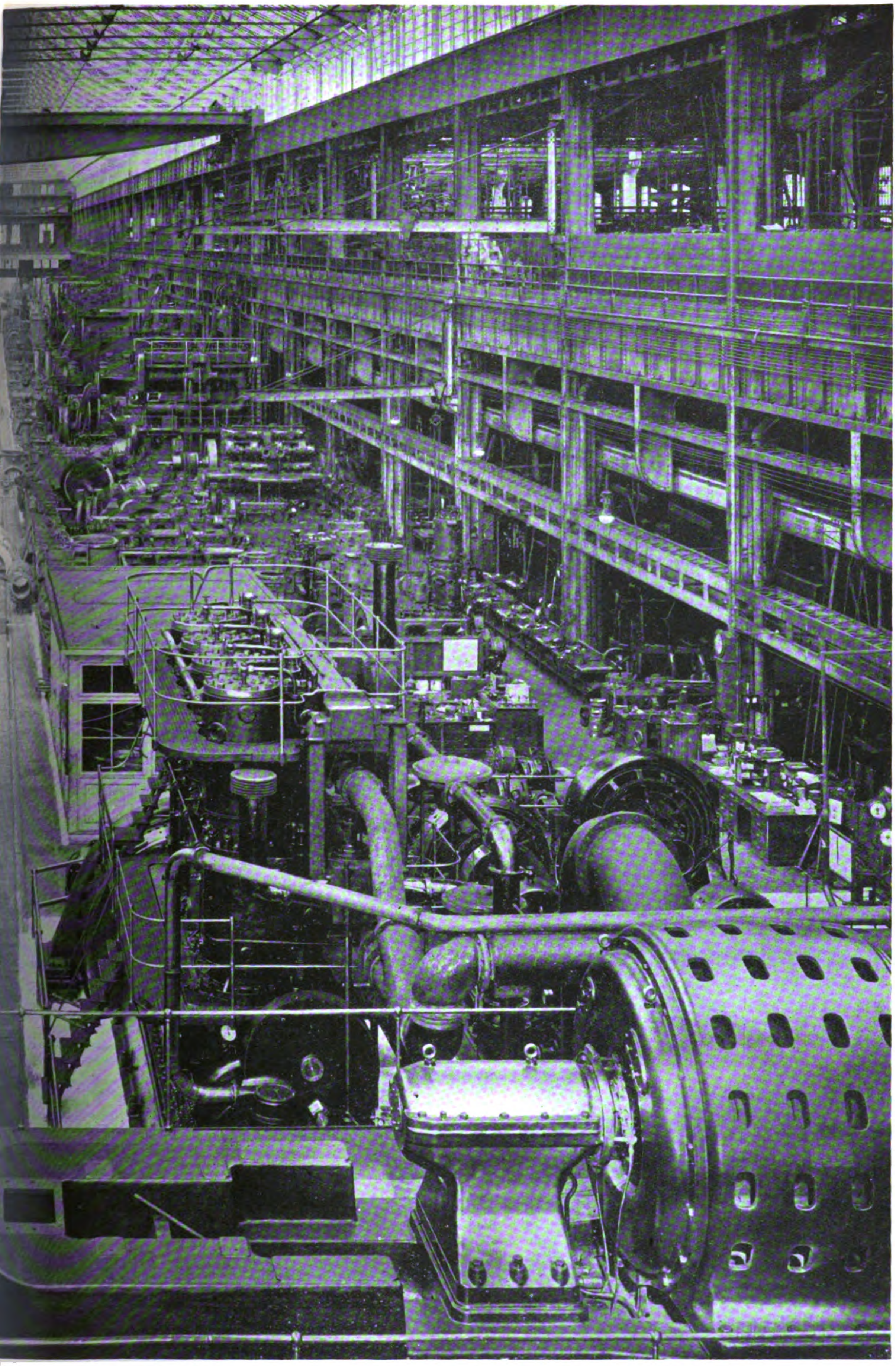
MEXICO.—Mexican General Electric Co., Mexico.

NEW ZEALAND.—The National Electrical and Engineering Co., Ltd., Auckland, Christchurch, Dunedin and Wellington.

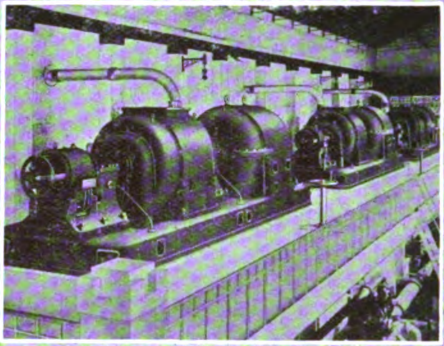
PERU.—W. R. Grace & Co., Lima.

SOUTH AFRICA.—The South African General Electric Co., Johannesburg and Capetown; Johnson & Fletcher, Bulawayo and Salisbury.


THE
BRITISH WESTINGHOUSE
Electric & Manufacturing Co Ltd
View of
One of the Aisles in the Works
Trafford Park - Manchester - England

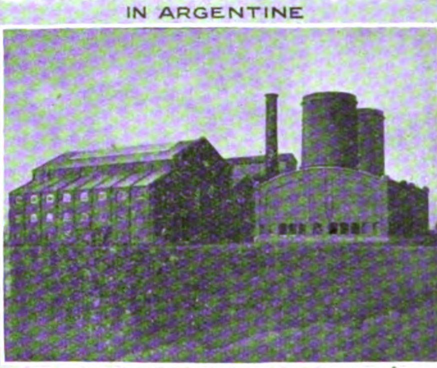


IN JAPAN



POWER STATION PLANT.

IN ARGENTINE



POWER STATION PLANT.

IN WEST AFRICA

GOLD MINE POWER PLANT.

IN EGYPT

ELECTRIC TRAMWAY EQUIPMENT.

The British Westinghouse

Our Resources

OUR STAFF includes some of the world's cleverest engineers—men who have solved power problems in all parts of the world—and their knowledge and experience is available to enable us to advise you on the equipment most suitable for your purpose.

OUR WORKS are the largest of their kind in the British Empire and occupy over 80 acres, 32 acres being roofed in. They provide regular employment for over 8000 workpeople who have all the assistance that modern appliances and scientific organisation can give.

OUR GUARANTEE.—We manufacture everything for the production, distribution, and application of electricity for power, lighting and heating purposes, and can offer you all the advantages that accrue from undivided responsibility for the installation of a complete power plant.

" The name Westinghouse is a guarantee."

Westinghouse
Manchester

Home Addresses:

Registered Office:

LONDON : Westinghouse Buildings, Norfolk Street, Strand, W.C.

Telegraphic Address : "Multiphase, Estrand, London."

Cable Address : "Multiphase, London."

Telephone Nos. 3261 to 3265 Gerrard.

Codes used : Westinghouse, Lieber, and A B C (5th Ed.)

—

Head Office & Works:

MANCHESTER : Trafford Park.

Telegraphic and Cable Address: "Westinghouse, Manchester." Tel. Nos. 190 to 197 Trafford Park

Branch Offices and Stores:

BIRMINGHAM — Avebury House, 55, Newhall Street *Tel. Nos. 2570/1 Central.*

CARDIFF — 102, St. Mary St. *Tel. No. 4712* (2 lines.)

GLASGOW — 17, St. Vincent Place. *Tel. Nos. 9820/2 Central.*

LEEDS — 20, Russell Street, Park Row. *Tel. No. 5011 Central.*

LONDON — 2, Norfolk Street, Strand. *Tel. Nos. 3261/5 Gerrard,* & * 179, Wardour Street W. *Tel. Nos. 7857 and 3261 Gerrard.*

MANCHESTER - Long Millgate *Tel. Nos. 6230/3 City.*

NEWCASTLE-ON-TYNE — Ward's Buildings, High Bridge. *Tel. Nos. 529 & 568 Central.*

SHEFFIELD — Howard Gallery, Chapel Walk, *Tel. 4644* (2 lines).

Telegraphic Address for all Branch Offices: "Multiphase" (with name of town).

* *Tel. Address: "Westelec, Ox, London."*

Foreign Addresses :

EUROPE.

Agents:

CHRISTIANIA - Westinghouse Norsk Elektrisk Aktieselskap. 21, Prinsensgade. (For Norway).

STOCKHOLM — G. Svalling, 8 Kungsholmstorg. (For Sweden).

BARCELONA — Electric Supplies Co., S.A., Apartado 507. (For Catalonia and Balearic Is.)

MADRID — Electric Supplies Co. S.A., Recoletas 2.

GIJON — E. S. Co., S.A., Marques S Estaban.

BILBAO — E. S. Co., S.A., Apartado 224.

PETROGRAD — The Russian Electric Co., "Dynamo" Ltd., 17, Bol. Konushennaya.

MOSCOW - The Russian Electric Co., "Dynamo" Ltd., Mjasnitzkaya 13. (For Russia.)

Trafford Park,

lectric & Mfg. Co., Ltd.

Our Products

POWER PLANT.—Steam Turbines, Turbo-Blowers and Compressors, Condensers, Air Pumps, Gas Engines, Oil Engines, Diesel Engines, Turbo- and Engine-driven Electric Generators, etc.

POWER DISTRIBUTION APPARATUS.—Rotary Converters, Motor Generators, Transformers and Static Balancers, Switchboards, Automatic Voltage Regulators, Switchgear, Fuses, Instruments and Meters of every description.

TRACTION EQUIPMENT.—Complete schemes for Electric Railways and Tramways, Petrol Electric Cars, Electric Locomotives, and Tramway Motors, Controllers, Magnetic Brakes, and Accessory Apparatus.

INDUSTRIAL EQUIPMENT.—Electric Motor Equipments of any capacity from $\frac{1}{20}$th hp. upwards complete with starting and control apparatus for driving mining, textile, domestic and industrial machinery of all kinds.

ELECTRICAL SUPPLIES.—Westinghouse Metal-filament and Carbon-filament Incandescent Lamps and Fittings, Electric Fans, Heating and Cooking Apparatus, Cables and Wires, Conduits and Fittings, and Electrical Accessories of every description.

Westinghouse
Manchester

oreign Addresses:

(Continued)

FRICA.

Office:

HANNESBURG — Consolidated Buildings. (Central Office for South Africa). Mangr. A. E. Du Pasquier

l. Address: "Converter," Johannesburg.

Agents:

RBAN — Thomas Barlow & Sons, P.O. Box 1011, Durban. (For Natal).

PE TOWN—E. A. Shaw & Co., 40, Burg Street.

MERICA.

Agents:

ENOS AYRES – Agar Cross & Co., Ltd., Casilla de Correo, 497. (For Argentine, Uruguay & Paraguay)

IQUE—J. K. Robinson, Casilla No. 704. (For Chile, Peru, Bolivia & Ecuador).

DE JANEIRO—F. H. Walter & Co., Caixa No. 23. (For Brazil.)

CITY OF MEXICO—Compania Ingeniera Importadoro-y-Contratista, S.A., 2a Capuchinas 49, Apartado No. 303. (For Mexico.)

ST. JOHN'S–Reid Newfoundland Co. (For Newfoundland.)

ASIA.

Offices:

CALCUTTA—B5 Clive Bldgs (Central Office for India.) Manager: G. Laird. *Tel. Address: "Multiphase, Calcutta."*

BOMBAY—H. N. Dutton, Post Office Box 323.

Agents:

MADRAS—Best & Co., Ltd., P.O. Box 63.

RANGOON–Stewart Raeburn & Co., P.O. Box 234. (For Upper & Lower Burmah).

SINGAPORE—Central Engine Works, Ltd., and at Kuala Lumpur & Johore Bahru. (For Malay Peninsula, Federated Malay States and British Borneo).

TOKIO—Takata & Co., No. 1 Yeiracucho 2 Chome, Kojimachi Ku (and at Osaka). (For Japan and Korea.)

AUSTRALASIA.

Office:

MELBOURNE—Queensland Building, 84, William St. (Cent. Office for Australia) Manager: A. Mc.Kinstry. (For Australia, Tasmania and the Pacific Islands). *Tel. Address: "Westimult, Melbourne"*

Agents:

SYDNEY—Standard Waygood Hercules Ltd., 77, King St. (Agents for N.S. Wales and Queensland).

MELBOURNE—Elder Smith & Co., Ltd., 84-88, William Street. (For Victoria and Tasmania.

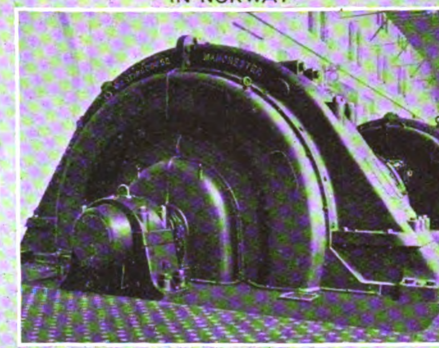
ADELAIDE—Elder Smith & Co., Ltd., 27-31, Currie St. (For South Australia and Broken Hill District of N.SW.

PERTH—Elder Shenton & Co., William Street. (For Western Australia.)

Turnbull & Jones Ltd., (for New Zealand):
WELLINGTON—Blair St.
AUCKLAND—41-47 Shortland Street.
CHRISTCHURCH—Cashel St.
DUNEDIN—Stuart St.

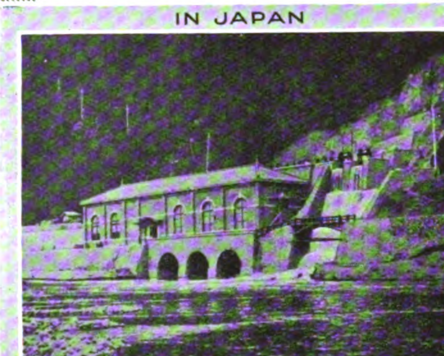
Manchester, England.

IN NORWAY



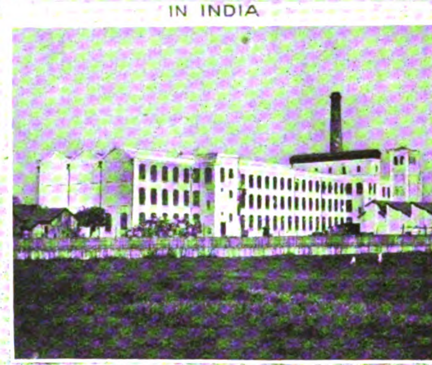
HYDRO ELECTRIC PLANT.

IN JAPAN



HYDRO ELECTRIC PLANT.

IN INDIA



INDUSTRIAL EQUIPMENT.

IN ENGLAND

ELECTRIC TRAIN EQUIPMENT.

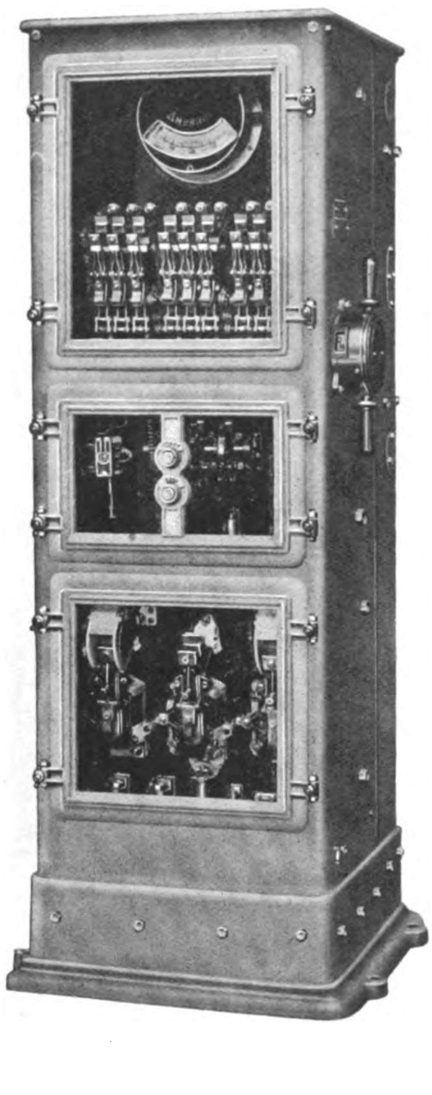
BROOK HIRST & Co. LTD

NORTHGATE ELECTRICAL WORKS

CHESTER

Wires: "Switches, Chester"

Telephone 971 Chester



Large D.C. Motors can be satisfactorily started and protected under the most severe conditions by

'BROOKHIRST'

Multiple Lever Type

Starting Panels

Special Features.

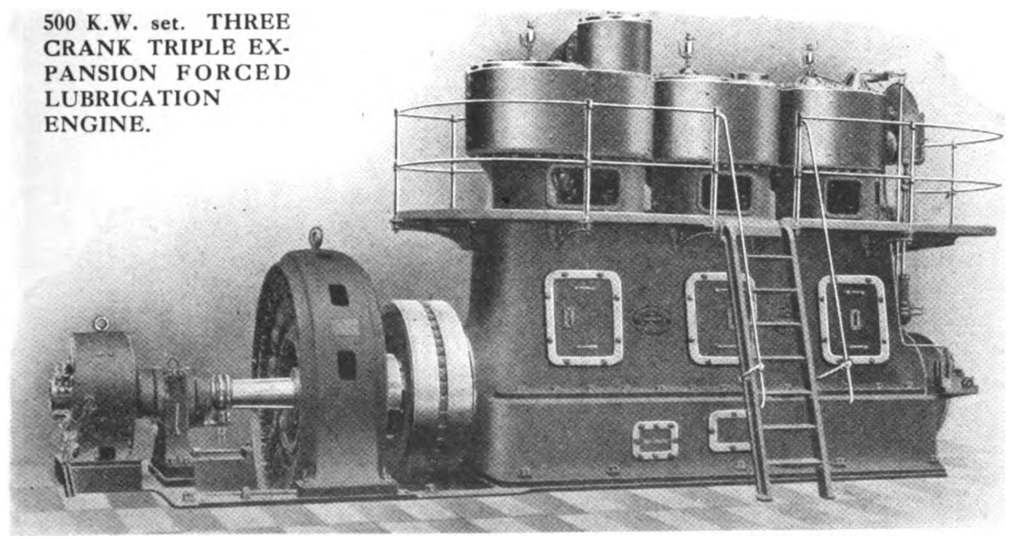
The separate steps of the starter are operated by *one* handle of the ratchet type, which gives a step by step movement to the switch levers.

The circuit is made and broken upon two single pole electrically operated contactors with magnetic blow-outs, controlled from the starter handle and providing the No-volt release feature.

Independent solenoid type overload trips are fitted in each pole, and are effective during and after starting.

Complete Ironclad Switchgears

Covering Motor Starting requirements up to 450 H.P. are fully detailed in Catalogue No. 3, now available



500 K.W. set. THREE CRANK TRIPLE EXPANSION FORCED LUBRICATION ENGINE.

COLE MARCHENT AND MORLEY LTD.

BRADFORD ENGLAND

REG. TRADE MARK.

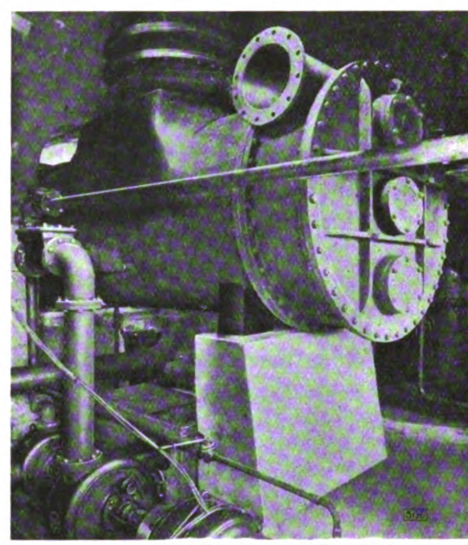
Builders of

STEAM ENGINES

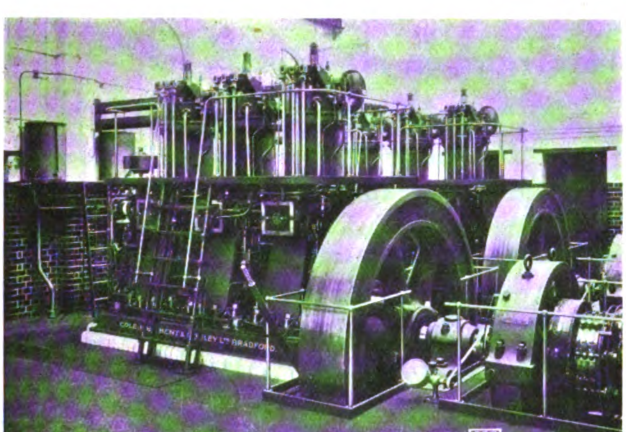
Slow Speed, Medium Speed and Central Exhaust (Uniflow).

CONDENSING PLANTS

Surface, Low Level Jet, Barometric Jet Types. With Reciprocating or Rotary Air Pumps.



SURFACE CONDENSER (4900 sq. ft.) WITH ROTARY OUTFIT.



Two 150 B.H.P. DIESEL OIL ENGINES WITH GENERATORS.

DIESEL ENGINES

From 50 B.H.P. Upwards.

CONTRACTORS FOR COMPLETE POWER INSTALLATIONS

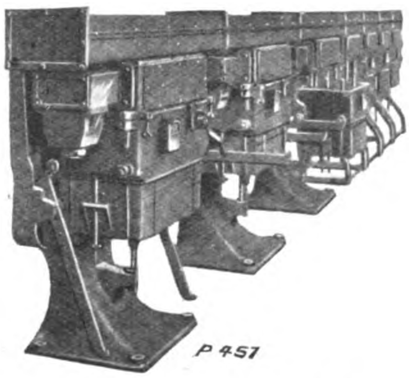
ON looking back through the history of the century, no one can fail to appreciate the part played by Great Britain. It was she who determined the fate of the modern world at Trafalgar and Waterloo; it was she who checked the aggressions of Russia in Turkey and in the East; it was she who bridled the ambitions of Germany; it was she who rendered abortive the coalition forming against the United States at the outbreak of the war with Spain. In inventions, in industries, in political institutions, in scientific theories, even in social fashions, all Europe has taken her as a model. Americans, in particular, have relied on her to police the globe and keep distant markets open, allowing them to sit at home and reap the advantage without cost and without danger.

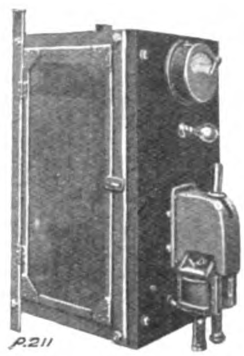
—*America's Economic Supremacy*,
by BROOKS ADAMS.

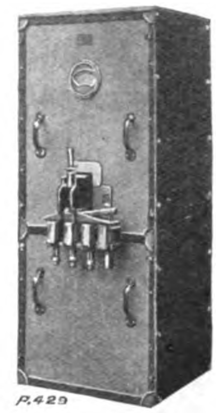
MANUFACTURERS OF ALL KINDS OF SWITCHBOARDS AND

A.C. & D.C. SWITCHGEAR

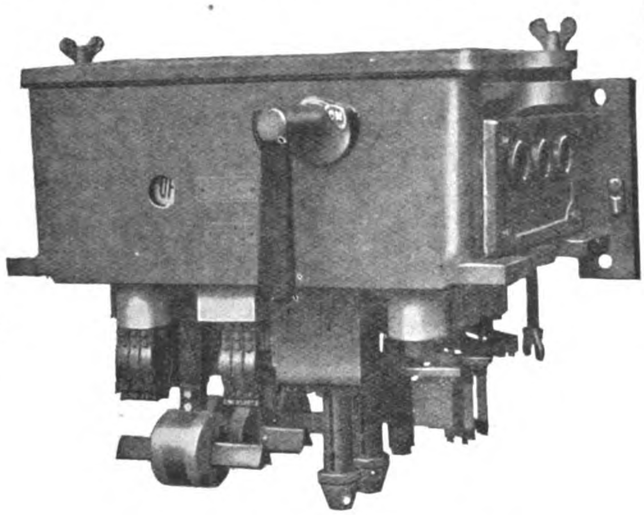
Contractors to ADMIRALTY, WAR OFFICE, INDIA OFFICE, PRINCIPAL RAILWAY COMPANIES, - COLLIERIES, Etc.



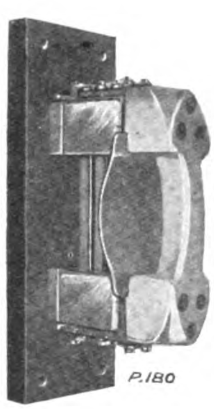


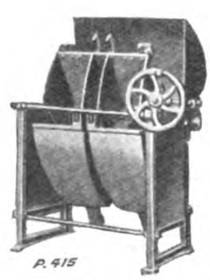


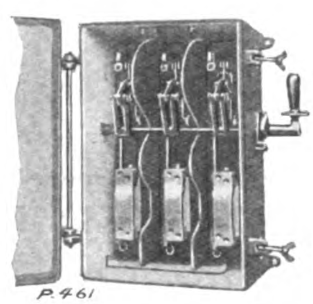
ALL PARTS ARE INTERCHANGEABLE

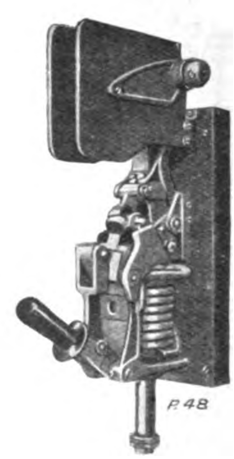


SOLID MECHANICAL CONSTRUCTION









ECKSTEIN HEAP & Co., Ltd.

Lancashire Switchgear Works,

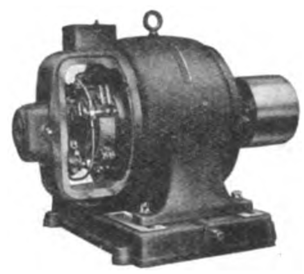
BROUGHTON, MANCHESTER.

NEW ZEALAND. Jas. J. Niven & Co., Ltd., Wellington.

CALCUTTA. Heatly & Gresham, Ltd., Waterloo St.
BOMBAY, Heatly & Gresham, Ltd., Hornby Road.

MOTORS AND DYNAMOS

Continuous Current
1 to 100 H.P.

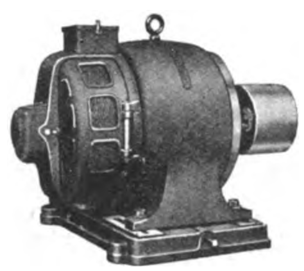


Open protected.

British built throughout.

Sound in construction ensuring freedom from breakdown.

Represent the latest practice because we make nothing else.



Enclosed Ventilated.

High efficiency and free from commutation troubles.

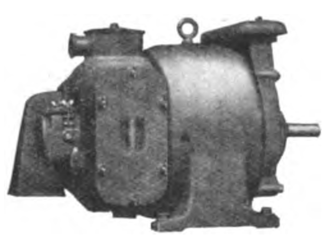
Competitive in price, rating for rating.

Stocks available in Australia, India, and New Zealand.

"Magnet." Manchester
"A. B C., 5th Edition."

Electromotors Limited

OPENSHAW:
Manchester, **England.**



Pipe Ventilated.

TRANSVAAL & RHODESIA. Reath & Co., Johannesburg.

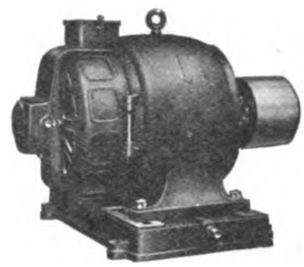
NATAL. A. B. Jones, Ltd., Durban.
ARGENTINE. Angel, Muzzio é Hijos, Rosario.

CTORIA, TASMANIA & SOUTH AUSTRALIA. Horrocks, Roxburgh Pty, Ltd., Melbourne.

NEW SOUTH WALES & QUEENSLAND. T. K. Steanes, Pitt Street, Sydney.

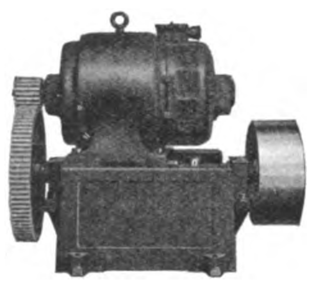
MOTEURS ET DYNAMOS

à courant continu,
de la force de 1 à 100 chevaux.



Totally Enclosed.

Fabrication entièrement anglaise. Construction très robuste garantissant contre tout danger de panne. Ces machines constituant notre seule spécialité, elles incarnent les derniers perfectionnements. Rendement élevé et absence d'hypercommutation ou hypocommutation nuisibles. Défient toute concurrence de prix à capacité égale. Stocks prêts pour la livraison en Australie, aux Indes et en Nouvelle Zélande.

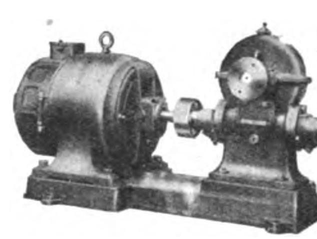


With Reduction Gear.

"Magnet." Manchester.
"A. B. C., 5TH Edition."

Electromotors Limited

OPENSHAW:
Manchester, England.



With Worm Gear.

.LAND. G. W. E. Gibson, 55 Stadhoudersplein, The Hague.

GREECE. J. McD. Barbour, Vulcan Works, Piræus.
MADEIRA. Raleigh C. Payne, Caixa, No. 17.


OSRAM
PATENT
G.E.C.
MADE IN ENGLAND
OSRAM

THE illustration depicts the laying of HENLEY'S CABLES in Buenos Ayres for the B.A. Western Railway Suburban Lines Electrification. We keep a staff of skilled engineers and workmen who have carried out the installation of Electric mains of all types in many parts of the World. The experience thus gained enables us to advise you and to quote favourable terms for any system or situation anywhere.

We will, of course, quote for the supply only of Electric Cables and Wires in any quantity, and in sizes from the smallest to the largest.

The name of Henley has been associated with the Electrical Industry since the year 1837.

TRADE MARK

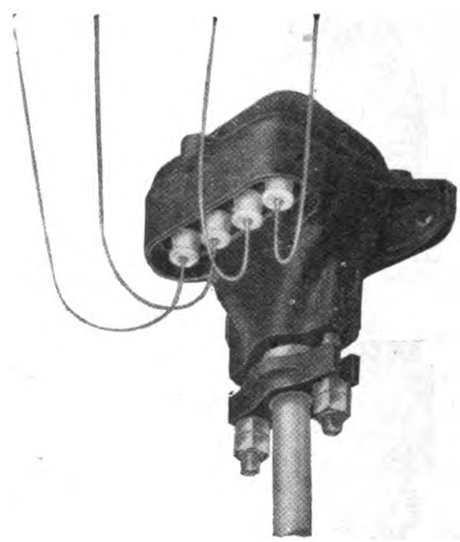
HENLEY'S CABLES AND JOINT BOXES

TRADE MARK

HENLEY PATENT TERMINAL BOXES

Cheapest to connect up
Automatic Bonding
Plumber-Jointer unnecessary
Immediate Delivery

Full Particulars see Catalogue - **T104**



W. T. HENLEY'S TELEGRAPH WORKS Co. Ltd.

Works:—
NORTH WOOLWICH and GRAVESEND.

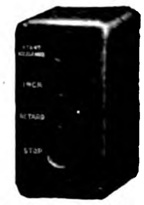
BLOMFIELD STREET,
LONDON, E.C.

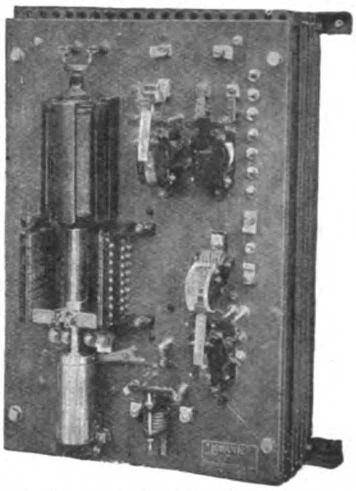
Telephones:—
4560 LONDON WALL (7 lines).

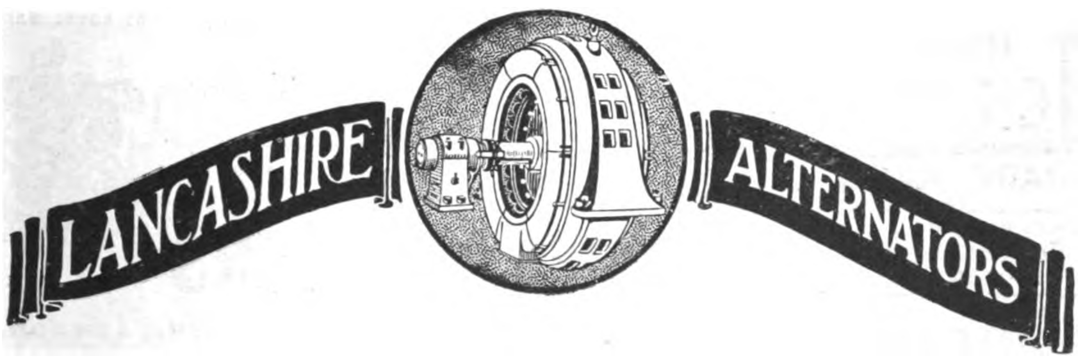
Telegrams: "HENLETEL, AVE, LONDON," and "HENLETEL" ALL HOME BRANCHES. Cables: "HENLEY'S, LONDON"

PRINCIPAL COLONIAL AND FOREIGN BRANCHES:—

546-550, Collins Street, Melbourne.
61, York Street, Sydney.
20/21, Standard Bank Chambers, Johannesburg.
19/23, Blair Street, Wellington, N.Z.
13/1, Clive Row, Calcutta.
7, Hummum Steet, Bombay.
Coristine Buildings, Montreal.
Heerengracht 209, Amsterdam.
Suipacha, 602 esq., Tucuman, Buenos Ayres.
Khedivial Buildings, Sharia Emad El Dine, Cairo.
Klara Norra Kyrkogata 22, Stockholm.
Rue Scribe 7, Paris.
Prinsens Gate 21, Kristiania Studiestræde 5, Copenhagen,






LANCASHIRE
ALTERNATORS

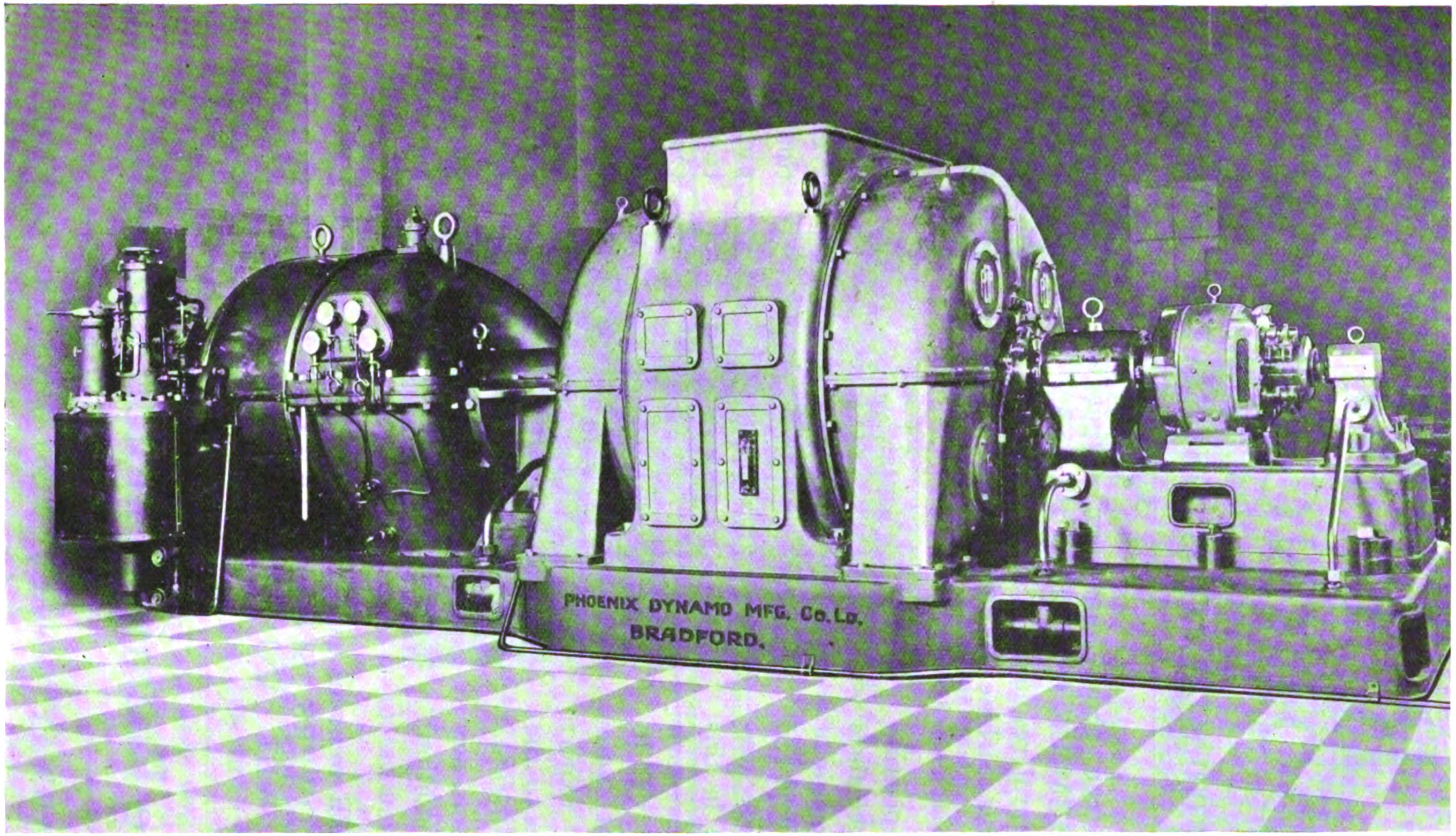
UNCHANGEABLE BRITISH TRADITION.

THE spirit of this people has produced its institutions; it is not its institutions which have produced its spirit; Prussia was a military nation in the bad sense of the word long before universal service was invented. The invention of universal military service has given the military spirit its weapon, but it has not created it. That spirit was there before universal service was started. Militarism is an affair of the heart, it is an affair of the disposition of a nation, and nothing will make me believe that any revolution of fate or fortune will turn this country, whose traditions have been continuous and unchanged.

The Hon. A. J. BALFOUR, *January 7, 1916.*

THE task of finding the greater part of the immense sums of money needed by the Allies is the special duty of the British people, for they in particular possess the necessary financial resources. Their manufacturing power has not been reduced by invasion, their cities have not been destroyed, their ports have not been shut off from the rest of the world, and their income has not been diminished by the absence of tourists and by other circumstances. Indeed, the income of the British people has been maintained at a very high level. Their exports, though not as great as before the War, are greater than they were as recently as 1909, their income from interest on capital invested abroad has been reduced but little, the earnings of their ships are greater than ever, and their factories are working full time. Moreover, the effect upon the production of the nation of the mobilization of a great army has been largely neutralized by the more vigorous and effective work of the civilian population in general and of the women in particular.

—*The Bankers' Manifesto*,
issued in December.



1200 K.W. TURBO-ALTERNATOR 6600 Volts., 3000 R.P.M.

THE CLASSIFIED DIRECTORY OF MANUFACTURES

in this Journal is a most valuable assistance to buyers. The classifications have been made with care to facilitate reference, and the cross indices in French, Spanish and Russian enable the purchaser familiar with these languages to find readily the article he is seeking under the English name. Readers should consult this Directory and write direct to members, whose names and full addresses are given at the end.

REES ROTURBO

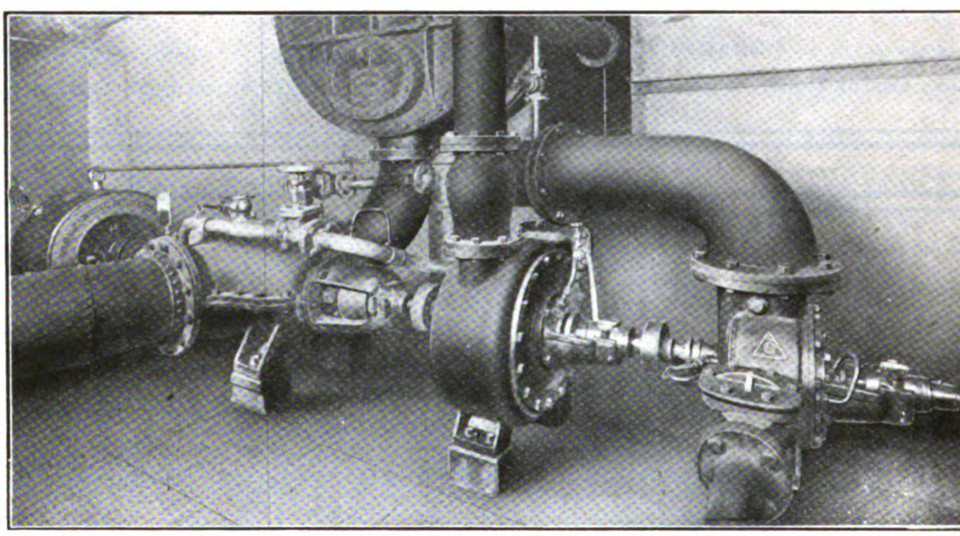
PATENT PRESSURE CHAMBER CENTRIFUGAL

PUMPS

FOR ALL PURPOSES.

INCLUDING AUXILIARIES FOR

CENTRAL POWER STATIONS



Rees Roturbo Patent Rotary Outfit for Surface Condenser, comprising Patent Air Pump, Circulating Pump and Extraction Pump. Turbine Driven.

DYNAMOS AND MOTORS.

The REES ROTURBO Mfg. Co., Ltd.

HYDRAULIC, ELECTRICAL AND GENERAL ENGINEERS,

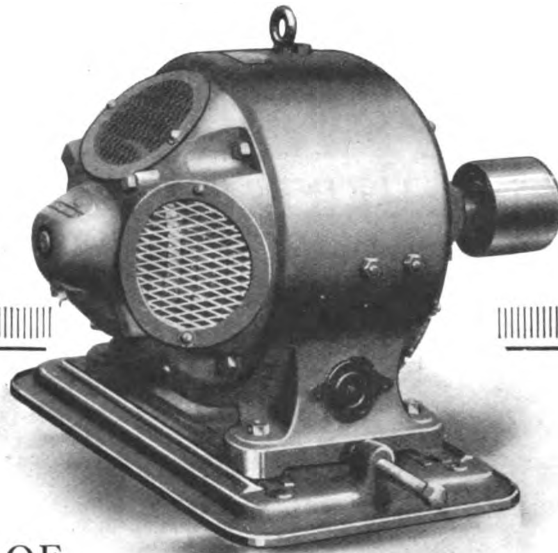
WOLVERHAMPTON, ENGLAND.

TELEGRAMS—
HYDROTURBO, WOLVERHAMPTON.
HYDROTURBO, ESTRAND, LONDON (Inland only).

ON ADMIRALTY, WAR, INDIA, HOME AND COLONIAL OFFICE LISTS.

TELEPHONES—
No. 900 Wolverhampton.
Nos. 1511, 1512 Central, London.

LONDON OFFICE: HASTINGS HOUSE, NORFOLK STREET, STRAND, W.C.



MAKERS OF

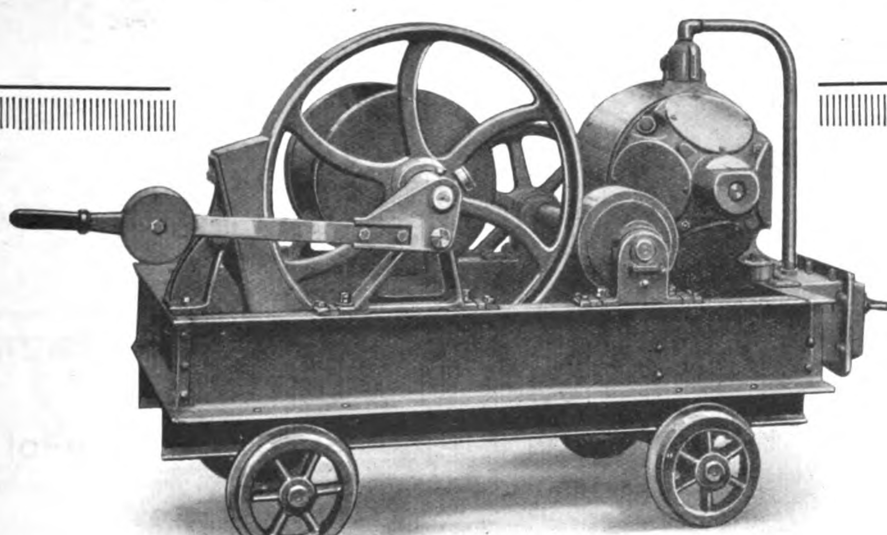
Dynamos	Continuous Current	Type	R.E.	List	115	C.E.X.
Motors	" "	"	R.E.	"		"
"	Squirrel Cage Polyphase	"	R.S.	"	230	C.E.X.
"	Slipring Polyphase	"	R.H.	"		"
	SINGLE PHASE.					
"	Repulsion Induction (To start against full load)	"	R.M.	"	101	E.X.
"	Repulsion only (Variable Speed)	"	R.Z.	"	100	A.E.X.
"	Repulsion Induction (Reversible)	"	R.F.	"	100	A.E.X.
"	Repulsion Induction (To give double full load torque at starting)	"	R.X.	"	100	A.E.X.

Lift and Crane Motors a speciality.

RHODES' MOTORS, L$^{\underline{TD}}$

Code used: A.B.C. 5th.
Telegrams: Rhodique, Doncaster.

DONCASTER



Extensive Type.

The Ideal System

OF

INDUSTRIAL LIGHTING

Ideal because it combines the highest efficiency and economy with an entire absence of trouble.

SUNLITE "P.E." REFLECTORS AND HALF-WATT LAMPS

Semi-Indirect Fitting.

HALF-WATT LAMPS cost less to install and maintain than arc lamps. There are no troublesome carbons to look after. They are robust, will stand a considerable amount of vibration, and retain their high efficiency over a long life.

THE REFLECTORS are designed to ensure correct distribution of light from half-watt lamps. Six types for all lamps from 100 to 3,000 C.P. cover all the requirements met with in practice. Of these we illustrate two—EXTENSIVE TYPE for distributing light over large areas. Other types of this class include, Extra Extensive, Parabolic Intensive and Angle Parabolic.

SEMI-INDIRECT TYPE, gives a beautifully diffused light, particularly suited to close and delicate work of all kinds, *e.g.*, drawing offices, marking-off rooms, etc. An indirect fitting is also available.

Let us send you full particulars with examples of characteristic light curves, or tell us your requirements and we shall be pleased to submit suggestions.

Code:
A.B.C.,
5th Edn.

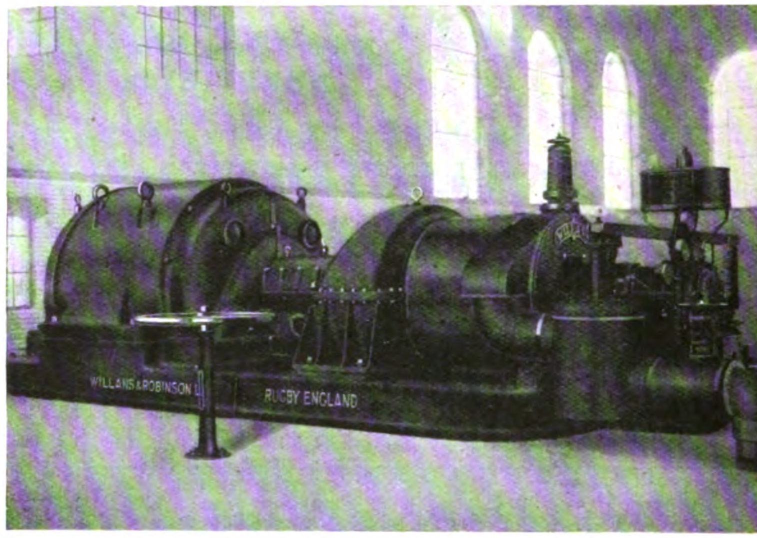
The Sun Electrical Company Ltd.

118-120 Charing Cross Road, London, W.C.

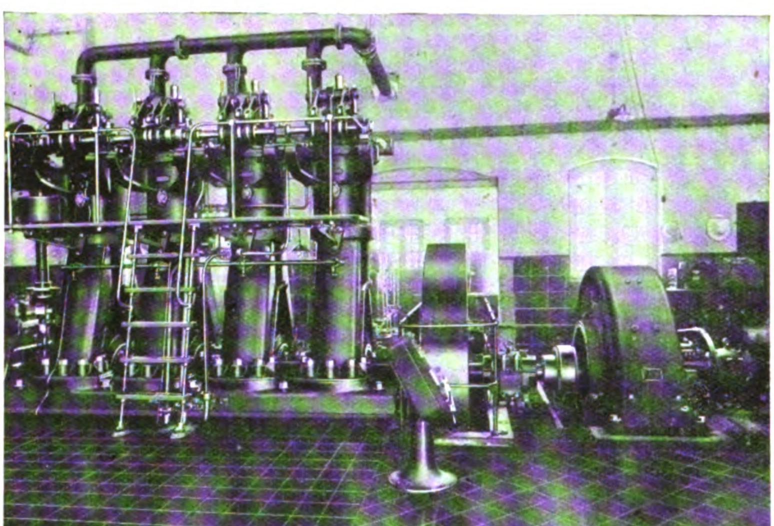
Cables:
Secabilis,
London.

Steam Turbines.

Illustration shows a
WILLANS
STEAM TURBINE
and
SIEMENS
ALTERNATOR
3000 K.W.
3600 R.P.M.
installed at Regina, Canada.



Diesel Engines.



Simplicity in design and high quality of materials and workmanship.

NINE YEARS' ACTUAL MANUFACTURING EXPERIENCE REPRESENTING OVER 27,000 H.P.

Illustration shows a 225 B.H.P. Willans Diesel Engine installed at Mandalay.

Willans & Robinson, Ltd.

Victoria Works, Rugby, England.

Foreign Branches and Representatives:

AUSTRALIA.—Willans & Robinson, Ltd., G.P.O. Box, 447, Sydney, N.S.W.
ARGENTINE.—J. F. Macadam & Co., 302, Balcarce, 326, Buenos Aires.
CANADA.—Willans & Robinson, Ltd., 213, Kerr Block, Regina; W. A. Martin & Co., 70, Lombard Street, Toronto; Rudel Belnap Machinery Co., Canadian Express Building, Montreal.

CHILI.—Mitrovich Hermanos, Iquique.

EGYPT.—Sayer & Colley, 31, Savoy Chambers, Cairo.

MALAYSIA.—Central Malay Motor & Eng. Works, Kuala Lampur, Selangor.

RUSSIA.—Hugh Ledward, P.O. Box 455, Moscow.

WHAT THEY SIGNIFY.

The central heart of the British Empire is in these Northern islands. As long as this heart beats life will flow through the arteries of the Empire and the pulsation will be felt in all those united countries on which the sun never sets.

The world needs the British Empire because, as it has grown, it has brought into realization the longings of men for Self-Government, Justice and Liberty. These ideals have been wrought out by centuries of endeavour in this country and have been carried around the world by the pioneers—the colonists and traders of the British race.

The export trade is necessary to maintain British standards of conduct among men ; for it nourishes the vital fluid in the arteries of the Empire.

British products mean a great deal more than the machinery, instruments, lamps, accessories, etc., that are announced and described in these pages. They signify the integrity of the people who inhabit these Northern islands. They denote the thoroughness, reliability, honesty and *quid pro quo* qualities which have given this country its standing all over the globe.

These manufactures are advertised in order to carry on the export business of the country and not to under-sell the products of any other nation ; they are sent to all parts of the world and are bought by those who desire to secure reliable, first-class goods. Added to this sound business reason for purchasing British goods, there is another deeper reason why buyers now prefer them ; they wish to contribute to the continuance of the British Empire and to support Great Britain in this titanic war for Human Rights.

THE WORLD'S MONEY.

Currency: G = Gold; S. = Silver; P. = Paper.

	English. £	s.	d.	Latin Union. Frs.	America. Dollar.	German. M.
Argentina G. 1 Peso = 100 Centavos, Silver		3	11⅞	5.00	0.97	4.05
1 Peso = 100 Centavos, Paper		1	9	2.21	0.43	1.75
Australia G. Same as Great Britain						
Austria. 1 Krone = 100 Heller			10	1.05	0.20	0.85
Belgium[1]) G. u. S. 1 Franc = 100 Centimes			9½	1.00	0.19	0.81
Bolivia S. 1 Boliviano = 100 Centavos, Silver		1	7	2.00	0.38	1.62
Borneo (British) Same as Straits Settlements.						
(Dutch) Same as Netherlands						
Brazil[2]) G. 1 Milreis, on Gold basis = 1000 Reis		2	3	2.83	0.55	2.29
1 Milreis, currency Exchange 15 d—19 d = 1000 Reis		1 bis 1	3 bis 7	1.58—2.00	0.30—0.39	1.28—1.62
British East Africa Same as British India						
British Guiana Same as British India						
British Honduras S. 1 Dollar = 100 Cents		4	1⅜	5.18	1.00	4.19
British India[3]) G. 1 Rupee = 16 Anna, Silver		1	4	1.68	0.32	1.36
British West Indies 1 Dollar = 100 Cents, fixed value		4	2	5.25	1.01	4.25
Canada G. 1 Dollar = 100 Cents		4	1⅜	5.18	1.00	4.19
Ceylon 1 Rupee = 100 Cents		1	4	1.68	0.32	1.36
Chile G. 1 Peso Fuerte = 100 Centavos Silver		1	6	1.89	0.36	1.53
China[4]) S. 1 Haikwan Tael = 10 Mace = 100 Centavos Silver, fluctuating		2	6	3.15	0.61	2.55
Cochin China 1 Piastre = 100 Centimes, Silver		2	3	2.83	0.55	2.29
Colombia G. 1 Peso = 100 Centavos, Silver		4	1⅜	5.18	1.00	4.19
1 Peso = 100 Centavos, fluctuating Currency, about		—	½	0.05	0.01	0.04
Costa Rica G. 1 Colon = Centesimos, Silver		1	11	2.41	0.47	1.95
Cuba 1 Peso, Spanish, Gold		3	9¼	4.75	0.92	3.85
1 Peso = 5 Pesetas = 10 Reales, Silver		3	7½	4.57	0.88	3.70
Curacao Same as Netherlands						
Denmark G. 1 Krone = 100 Oere		1	1⅕	1.39	0.27	1.12
Ecuador G. 1 Sucre = 25 Pesetas = 100 Centimos, Silver		2	0	2.52	0.49	2.04
Egypt G. 1 Piastre Tariff = 100 Milliemes = 40 Paras			2½	0.26	0.05	0.21
France[1]) G. & S. 1 Franc = 100 Centimes			9½	1.00	0.19	0.81
Germany G. 1 Mark = 100 Pfennige			11¾	1.23	0.24	1.00
Great Britain G. 1 Sovereign = 20 Shillings	1	0	0	25.23	4.86⅔	20.40
1 Shilling = 12 Pence		1	0	1.26	0.24	1.02
Greece[1]) G. & S. 1 Drachma = 100 Lepta, Silver at par			9½	1.00	0.19	0.81
Guatemala S. 1 Peso, Silver, fluctuating, about		1	8¼	2.12	0.41	1.72
1 Peso = 100 Centavos, Paper, about			3	0.32	0.06	0.26
Haiti G. & S. 1 Gourde = 100 Centimes (paper) about			8	0.84	0.16	0.68
1 Gourde = 100 Centimes Silver nominally		4	1⅜	5.18	1.00	4.19
Honduras S. 1 Peso, Silver = 100 Centavos, about		2	0½	2.59	0.50	2.09
1 Peso, Paper = 100 Centavos, about		1	9	2.21	0.43	1.79
Hawaii Same as United States						
Hongkong 1 Dollar = 100 Cents = 1000 Cash, Silver, fluctuating		2	2	2.73	0.53	2.21
Italy[1]) G. & S. 1 Lira = 100 Centesimi			9½	1.00	0.19	0.81
Japan G. 1 Yen = 100 Sen = 1000 Rin, Silver		2	0⅝	2.59	0.50	2.09
Java Same as Netherlands						
Madagascar 1 Franc = 100 Centimes			9½	1.00	0.19	0.81
Mexico S. 1 Peso = 100 Centavos		2	0⅝	2.59	0.50	2.09
Morocco S. 1 Hassani Dollar = 10 Dir hems (Silver), about		3	0	3.78	0.73	3.06
Netherlands (Holland) G. 1 Gulden = 20 Stuivers = 100 Cents		1	8	2.08	0.40	1.69
New Zealand Same as Great Britain						
Nicaragua S. 1 Peso = 100 Centavos, Silver, about		1	8¼	2.12	0.41	1.72
1 Peso = 100 Centavos, Paper, about			6	0.63	0.12	0.51
Norway G. 1 Krona = 100 Ore		1	1⅕	1.39	0.27	1.12
Panama G. 1 Peso = 100 Centavos		2	0⅝	2.59	0.50	2.09
Paraguay P. 1 Peso, Gold, nominally		3	11⅞	5.00	0.97	4.05
1 Peso = 100 Centavos, fluctuating, about			4	0.42	0.08	0.34
Persia S. 1 Kran = 20 Shahis = 1000 Dinars			4⅓	0.45	0.09	0.36
Peru G. 1 Sol = 10 Dineros = 100 Centavos		2	0	2.52	0.49	2.04
Philippine Islands 1 Peso = 100 Centavos		2	0½	2.59	0.50	2.09
Portugal[5]) G. 1 Milreis = 1000 Reis		4	5⅓	5.60	1.08	4.53
Portuguese India Same as British India						
Puerto Rico 1 Dollar = 100 Cents		4	1⅜	5.18	1.00	4.19
Russia G. 1 Rubel = 100 Kopeken		2	1⅜	2.66	0.51	2.16
Salvador 1 Peso = 100 Centavos, Silver, about		1	8¼	2.12	0.41	1.72
1 Peso = 100 Centavos, fluctuating currency, about		1	9	2.21	0.43	1.79
Santo Domingo 1 Dollar = 100 Cents		4	1⅜	5.18	1.00	4.19
1 Peso = 100 Centavos, Nickel			9⅞	1.04	0.20	0.84
Siam 1 Tical = 64 Atts		1	6½	1.94	0.37	1.57
Spain[1]) G. & S. 1 Peseta = 100 Centimos, Silver, at par			9½	1.00	0.19	0.81
1 Peseta = 100 Centimos Currency, about			8⅜	0.88	0.17	0.71

The World's Money

	English. £ s. d.	Latin Union. Frs.	American. Dollar.	German. M.
Straits Settlements 1 Dollar = 100 Cents, Silver	2 4	2.94	0.57	2.38
Sumatra Same as Netherlands				
Sweden G. 1 Kronor = 100 Oere	1 1⅛	1.39	0.27	1.12
Switzerland[1]) G. & S. 1 Franc = 100 Centimes	9½	1.00	0.19	0.81
Tunis Same as France				
Turkey G. 1 Piastre = 40 Paras	2¼	0.23	0.04	0.18
Union of South Africa Same as Great Britain				
United States G. 1 Dollar = 100 Cents	4 1⅛	5.18	1.00	4.19
Uruguay G. 1 Peso Oriental = 100 Centesimos, Silver	3 2	4.00	0.77	3.24
Venezuela G. & S. 1 Bolivar = 2 Reales = 20 Centavos	9½	1.00	0.19	0.81
Zanzibar Maria Theresa Dollar = 100 Cents, about	2 10	3.57	0.69	2.89

Notes to References.

[1]) The Latin Union includes Belgium, France, Greece, Italy and Switzerland. Gold coins and silver 5 Franc pieces of each country are legally current in each of the other States of the Union. The monetary system of Spain was assimilated to that of the Latin Union in 1872.

[2]) Brazil. One Conto currency = 1000 Milreis (Exchange 18 d) = Mark 1530; $364.99; £75; Frs. 1890.

[3]) British India. Lakh of Rupees (Rs. 100,000) = German M 136,000, American $32,443.33, English £6666 - 13 - 4, Latin Union Frs. 168,000.

[4]) China. In Canton, Amoy, Fooschow, Swatow and in many other places in China Dollars and Cents are current. Mexican and Spanish silver dollars are likewise in circulation. In the Chinese dollar coinage the relation of the dollar system to the tael is now on the basis of 72 tael cants (candareens) to the standard dollar.

[5]) Portugal. One Conto = 1000 Milreis, gold = Mark 4534.75; $1081.78; £222 - 5 - 10; Frs. 5601.75.

THE WORLD'S LINEAL MEASURE.

		Centimetre	Inches
Argentina	1 Metre	100.00	39.37
	1 Vara = 3 pies = 36 pulgadas	86.6	34.094
Australia	1 foot = 12 inches	30.48	12.00
Austria-Hungary	1 Metre	100.00	39.37
Belgium	1 Metre	100.00	39.37
Bolivia	1 Metre	100.00	39.37
	1 Vara = 3 pies = 36 pulgadas	84.9	33.43
Brazil	1 Metre	100.00	39.37
	1 Vara = 5 palmos = 40 pollegadas	110.00	43.30
British East Africa	1 Wari = 2 thiraa = 36 wanda	91.44	36.00
British India	1 foot = 12 inches	30.48	12.00
	1 Bengal guz = 2 hath	91.44	36.00
	1 Bombay guz = 2 tussoos	68.58	28.00
	1 Madras guz	83.8	33.00
British North Borneo	1 Ella = 2 hasta = 4 jankalls	91.44	36.00
British West African Colonies	1 foot = 12 inches	30.48	12.00
British West Indies	1 foot = 12 inches	30.48	12.00
Canada	1 foot = 12 inches	30.48	12.00
Ceylon	1 foot = 12 inches	30.48	12.00
Chile	1 Metre	100.00	39.37
	1 Vara = 3 pies	83—84	32—33
China	1 Canton Customs Chih = 10 tsin = 100 Fen by treaty (the metre is now called "sin tchi")	35.8	14.1
Colombia	1 Metre	100.00	39.37
Congo State	1 Metre	100.00	39.37
Costa Rica	1 Metre	100.00	39.37
	1 Vara = 3 pies = 36 pulgadas	83.8	32.992
Cuba	1 Metre	100.00	39.37
Danish West Indies	Same as Denmark		
Denmark	1 Metre	100.00	39.37
	1 Fod = 12 Tommer	31.4	12.36
Ecuador	1 Metre	100.00	39.37
Egypt	1 Metre	100.00	39.37
	1 Pic (Diraa Baladi) for Textiles	75.00	29.53
	1 Pic (Diraa Mimari) for Builders	58.0	22.84
Finland	1 Metre	100.00	39.37
France	1 Metre	100.00	39.37
Germany	1 Metre	100.00	39.37
Great Britain	1 foot	30.48	12.00
Greece	1 Metre	100.00	39.37
	1 Pik	68.6	27.00
Guatemala	1 Metre	100.00	39.37
Haiti	1 Pied = 12 pounces	32.5	12.79
Hawaii	Same as United States		
Honduras	1 Metre	100.00	39.37
Hongkong	1 Metre	100.00	39.37
	and same as China		
Indo-China	1 Metre	100.00	39.37
	1 Thouc = 10 tac	48.77	19.2
Italy	1 Metre	100.00	39.37
Japan	1 Shaku = 10 sun	30.30	11.93
	1 Shaku for cloth	37.9	15 00
Java	See Netherlands East Indies		
Morocco	1 Drah = 8 tominis	57.1	22.48
Mexico	1 Metre	100.00	39.37
	1 Vara = 3 pies = 12 pulgadas	83.98	32.992
Netherlands (Holland)	1 Metre	100.00	39.37
Netherlands East Indies	1 Metre (legal)	100.00	39.37
	old weight:		
	(a) Java 1 Foot = 12 duims	31.4	12.36
	(b) Sumatra 1 Etto = 2 junkals	45.72	18.00
Netherlands West Indies (Surinam, Curacoa)	1 Metre	100.00	39.37
	1 Fuss	31.4	12.36
Newfoundland	1 foot	30.48	12.00
New Zealand	1 foot	30.48	12.00
Nicaragua	1 Metre	100.00	39.37
Norway	1 Metre	100.00	39.37
Panama	Same as Colombia		
Paraguay	Same as Argentina		
Persia	1 Guz	104.00	40.95
Peru	Same as Chile.		
Philippine Islands	1 Metre	100.00	39.37
	1 Vara	83.6	32.91
Portugal	1 Metre	100.00	39.37
	1 Vara = 5 palmos = 40 pollegadas	111.1	43.75
Portuguese African Colonies	Same as Portugal		
Portuguese India	1 Vara	109.7	43.2
	1 foot	30.48	12.00
Puerto Rico	1 Metre	100.00	39.37
Russia	1 Archine = 2 Stopas = 16 verschoks	71.12	28.00
	1 Sazhen = 3 archines	213.36	84.00
Salvador	See Costa Rica		

The World's Lineal Measures.

		Centimetre	Inches
Santo Domingo	1 Metre	100.00	39.37
	1 Vara	83.6	32.94
Siam	1 Wah = 4 sok = 8 keup = 96 nin	203.2	80.00
Spain	1 Metre	100.00	39.37
	1 Vara Castellana = 3 pies = 36 pulgadas	83.6	32.90
	1 Vara de Cadiz = 1.013 vara castellana	84.7	33.33
	1 Vara de Barcelona = 0.93 vara castellana . . .	78.00	30.68
Straits Settlements	1 foot	30.48	12.00
Sweden	1 Metre	100.00	39.37
Switzerland	1 Metre	100.00	39.37
Tripoli	1 Metre	100.00	39.37
	1 Pike (for silk and cotton).	67.1	26.42
	Arabian Dhraa (ribbons).	84.3	19.02

		Centimetre	Inches
Tunis	1 Metre	100.00	39.37
	1 Pik or Dhraa arabi .	.46—49	18-19.21
	1 Pik or Dhraa tirki .	.64—69	25—27
	1 Pik or Dhraa endasseh	.64—67	25—27
	1 Pik or Dhraa andaluci .	66.7	26.26
Turkey	1 Metre	100.00	39.37
	1 Pik or Dhraa = 24 Kerats	68.6	27.00
	1 Endasse	65.2	25.69
Union of South Africa	1 Fuss or Cape foot. . .	31.4	12.40
United States	1 foot.	30.48	12.00
Uruguay	1 Metre	100.00	39.37
	1 Vara = 3 pies = 36 pulgadas	85.9	33.86
Venezuela	See Mexico.		
Zanzibar	1 Wari = 2 thiraa = 36 wanda	91.4	36.00

THE WORLD'S WEIGHTS.

* *Metric System* (1 Kilogramm = 1000 grammes) is legal in Argentina, Austria-Hungary, Belgium, Bolivia, Brazil, Chile, Colombia, Congo State, Costa Rica, Cuba, Danish West Indies, Denmark, Ecuador, Egypt, France, Germany, Greece, Guatemala, Honduras, Indo-China, Italy, Java, Madagascar, Mexico, Netherlands, Netherlands East Indies, and West Indies, Nicaragua, Norway, Panama, Paraguay, Peru, Philippine Islands, Portugal, Puerto Rico, Salvador, Santo Domingo, Spain, Sweden, Switzerland, Tripoli, Turkey, Uruguay, Venezuela.

* *English Weight* (1 Pound = 16 ounces = 7000 grains) is legal in Australia, British Honduras, British Giuana, British West African Colonies, British West Indies, Canada, Great Britain, Malta, New Zealand, Straits Settlements, Union of South Africa, United States.

1 Kilogramm (1000 Grammes) = 2.2046 lbs. (Pounds).
1 Pound (16 ounces) = 453.592 grammes.

	Other weights	Equivalents Metric Kilo-grammes	English Pounds (lbs)
*Argentina**	1 libra = 16 onzas . .	0.4594	1.0127
*Bolivia**	1 libra = 16 onzas . .	0.46	1.0147
*Brazil**	1 Arratel or Libra = 16 onças	0.459	1.0119
British East Africa	1 Ratel = 16 wakia . .	0.454	1.00
British India	1 Seer = 16 chittaks = 80 tolas	0.9331	2.057
	Indian or Bengal maund = 40 seers	37.324	82.286
	Madras maund = 40 seers	11.191	24.686
	Bombay maund = 40 seers	12.70	28.00
	Karachi maund = 40 seers	36.287	80.00
British Borneo	1 Catty = 10 taels = 100 mace	0.6048	1.33
*Chile**	1 Arroba = 25 libras .	11.502	25.358
*China**	1 Chin or catty = 16 liang or tael	0.605	1.33
	(1 Tan or picul = 100 chin.) (the kilogramme is now called "sin king")		
*Colombia**	1 Arroba = 25 libras .	12.50	27.558
*Costa Rica**	1 Arroba = 25 libras = 400 onzas	11.51	25.366
*Cuba**	1 Arroba = 25 libras .	11.51	25.38
Danish West Indies and	see Denmark		
Denmark	1 Punt = 100 Kvintin .	0.50	1.1023
	1 Centner = 100 Punt .	50.00	110.231
	1 Skippund = 320 Punt.	160.00	352.74
*Ecuador**	see Bolivia		
*Egypt**	1 Rotl = 12 uckieh = 144 dirhens	0.449	0.9905
*Greece**	1 Oke	1.282	2.834
*Guatemala**	see Costa Rica		
Haiti	1 Livre-poids = 16 onces	0.49	1.08
*Honduras**	see Costa Rica		
*Hongkong***	see China		
*Indo-China**	1 Can = 16 luong . .	0.6237	1⅜
	(1 Ta = 10 Yen = 10 Ocan)		
	1 Government Picul .	60.46	133.33
Japan	1 Kin or catty = 160 momme	0.60	1.323
	(1 Hiyak Kin or picul = 100 Kin)		
*Java**	1 Catty = 16 taels . .	0.618	1.356
*Madagascar**	1 Monscha	3.057	6.614

	Other weights	Equivalents Metric Kilo-grammes	English Pounds (lbs.)
*Malta***	1 Rotolo = 2½ libbri .	0.79	1.75
*Mexico**	1 Arroba = 25 libras = 400 onzas	11.506	25.366
Morocco	1 Rolta = 2½ libbri . .	0.79	1.75
	uckieh	0.508	1.12
*Netherlands West Indies**	1 Amsterdam Pound .	0.494	1.089
*Paraguay**	see Argentina		
Persia	1 Abassi = 5 seer = 90 miskals	0.368	0.811
	1 Ratel = 100 miskals .	0.46	1.014
*Peru**	1 Arroba = 25 libras .	11.52	25.391
*Portugal**	1 Arroba = 32 arrateis = 400 oncas. . . .	14.688	32.381
	1 libra	0.459	1.012
Portuguese India	see Portugal and British India		
*Puerto Rico**	see Cuba and United States		
Russia	1 Pfunt = 12 lanas = 32 lotti = 96 zolotniks .	0.4095	0.9028
	1 Pood = 40 Pfunts . .	16.38	36.113
*Santa Domingo**	1 Arroba = 25 libras .	11.5	25.35
Siam	1 Chang or Catty = 20 taels = 80 ticals . .	1.213	2.675
	(1 Hap or Picul = 50 Chang).		
*Spain**	1 Arroba castellana = 25 libras = 400 onzas .	11.5	25.36
Straits Settlements	1 Kati = 16 tahils . .	0.605	1.33
	(1 Pikul = 100 Katis)		
*Switzerland**	1 Pfund	0.50	1.102
Turkey	1 Oka = 4 okiehs = 400 dirhems	1.282	2.834
	1 Rotolo	0.566	1.247
*Union of South Africa***	Cape Hundredweight (Cwt.)	45.36	100.00
*United States***	1 Cental (instead of Cwt.)	45.36	100.00
	1 Short ton = 20 centals	907.185	2000.00
	1 Long ton = 37 bushels	1016.00	22.4000
*Uruguay**	see Argentina		
*Venezuela**	see Mexico		
Zanzibar	1 Ratel = 16 wakia .	0.45	1.00
	1 Frasila = 6 pishi = 36 ratels	15.329	36.00

* Metric system is legal.
** English system is legal.

Printed for the Proprietors by Percy Lund, Humphries & Co., Ltd., The Country Press, Bradford, and 3, Amen Corner, London, E.C. 24253

THE BEAMA JOURNAL

Vol. II No. 2 APRIL 1916

CONTENTS

NEWSPAPERS FOR NEUTRAL COUNTRIES.

The War Office notifies that from now onward all papers posted to any neutral European country will be stopped, except those sent by publishers and newsagents who have obtained special permission from the War Office.

Such permission has been granted to "The Beama Journal," and subscribers who send to friends in Denmark, Holland, Norway, Sweden, Switzerland, Spain, Portugal, Greece and Roumania should order copies to be despatched by the publisher from 36, Kingsway, W.C.

THE BEAMA JOURNAL

CONFUSED ISSUES AND POPULAR FALLACIES.

Never before in the history of Great Britain have certain classes called so helplessly upon the Government to come to their rescue, as many are now doing. It is a spectacle amazing to true British spirits to see the lack of self-confidence and initiative evinced by one manufacturer after another in their various letters to the press, and in the resolutions passed by them in different assemblies. The incoherent and heterogeneous suggestions are contradictory, half-hearted, confused and irresolute. On the surface it would appear that the business men of this country are incapable of thinking out the problems of the present crisis for themselves, as, apparently, they wish the Government to do it for them. Whoever or whatever a "Government" is, it cannot absolve the people, even were it infallible. In the end no one can delegate his responsibilities.

The questions that must be definitely answered to-day in industrial affairs are :—(1) What are the qualifications which the situation demands ? (2) Is it necessary that managers and organizers should have these qualifications, or is it more possible that government officials may possess them ? (3) If neither are qualified to outline a policy for immediate application, which of them are most likely to be able to acquire the necessary wisdom—men engaged in the industries or officials appointed by the Government ?

The qualifications are :—Experience in industrial management ; appreciation of the requirements for social advance, educationally and scientifically ; understanding of the relation of industry to other spheres of human effort ; knowledge of the laws operating in economic and political life ; perception of the meaning of individual and national life and their functions in the evolution of the race. Men with these qualifications will appreciate the need for the co-operation of other like-minded individuals before any policy can be planned, or an attempt made to carry it out. They will also be emphatic in declaring that political bias, class antagonism and self-interest must be laid aside in order to promote a higher self-interest, *viz.*, that of our corporate, national life.

This attitude cannot be brought about, however, by state measures ; it must be taken up by the people themselves.

Have British industrialists lost faith in themselves that they should lean supinely on a Government ? The statement that states are made for men, not men for states, leads often to a false conclusion. If man has made the State, it should therefore do as much as possible for him ! It should initiate, control and direct his affairs, and make matters so easy that the individual has nothing to do but step in and take advantage of the institutions created, of the industries established, of the markets secured, of the contracts obtained ! Such, indeed, appears to be the desire of many.

"What will be wanted in the future is strong Government advocacy and push for British products at the critical moment when contracts are being placed," declares one contributor to that most instructive editorial synopsis in *The Times Engineering Supplement*, Jan. 28th, 1916. The editor had abundance of material sent him, but apparently the mass was too heterogeneous to create out of it a constructive policy on simple, fundamental lines. Another correspondent says that the Government ought "to arrange conferences of the manufacturers in each line of business and *get them to work together*." In other directions we hear that the Government ought not to have let certain industries languish ; it has not considered its own people ; it has neglected science ; it has allowed our educational system to go to pieces ; it ought to appoint Trade Consuls, Trade Commissioners and a Ministry of Commerce.

MINISTRY OF COMMERCE.

A completely representative National Industrial Federation would constitute the most effective Ministry of Commerce. A purely Government body for this purpose would be *de trop*. But if industrialists and business men themselves organized a Board of Commerce, the Government could appoint members to it to represent certain State departments, and

recognize the organization as part of the social machinery.

Several Manufacturers' Associations, including our own, see the need for the formation of a Ministry of Commerce; but their request that the Government should give the matter attention and encouragement does not mean that they desire to leave it entirely in the hands of the Government.

It is surely necessary to clarify our ideas as to what are the functions of the different departments of the nation's life. The business of the country is carried on by the people; it is performed by the natural operation of the different parts of Society upon one another in their reciprocal relations. The Ministry of Commerce that would really assist industrialists would be a Board formed by themselves from amongst themselves. It would be a strange perversion of British character if industrialists were willing to take advice and direction from a body appointed by a Government. In reality their request for such an appointment hides a resentment towards outside interference, already so strong that it militates greatly against effective co-operation amongst themselves.

Nowhere have we yet seen stated what is to be expected from a Minister of Commerce. What is he to do? What is to be his function? He is to give "sympathetic help" to manufacturers, say some: "With a sympathetic Ministry of Commerce at the back of us the question of labour will settle itself." Is this then the motive for this new Government Department? Is it to be a department to protect employers and to ally itself with one sphere of commerce and against another? Fortunately for the country this motive does not predominate. Another says "It is our duty to formulate plans for the defence and improvement of our trade and employment after the war, and I am sure *we are all prepared to co-operate for this purpose, if we get the necessary leadership and permission to do so*"—in other words, if the pater says "No," it can't be done! We must be *led* along the road we want to go! We won't take the repsonsibility of leadership; but "if the Government does not take our advice, then the responsibility is theirs, not ours." The "cause of humanity" too sententiously espoused by many selfish patriots was never fought for by such cowardly knights as these.

Why has no Government appointed a Ministry of Commerce, although it has been asked to do so periodically since 1869? Simply because manufacturers and business men had formulated no plans and presented no lines of work for such a Minister to undertake; neither had they ever co-operated in such strength as to convince the Government in power that they knew what they wanted, and that the demand was really representative of the manufacturing community. Any Government endeavours to trim its sails more or less according to public opinion, and any Government with sense will try to avoid appearing like a body of fools by appointing a Minister with merely a nominal portfolio. No Minister of Commerce could move a step effectively without the co-operation, assistance and advice of business men and manufacturers; and unless it were a widely representative and voluntary co-operation, it would be ineffectual. Plans by the Minister would be baulked by those who opposed them. From one point of view some manufacturers and business men come out of an examination on commonsense looking less capable than the labourers who know what they want and unite to get it. Let us suppose the Government were to appoint a Minister of State to regulate commerce and to promote trade; let us suppose it even appointed a committee of business men to advise the Minister. If the appointments were made by the Government, on what basis would they be made? Party politics, personal influence and "rewards"—or what? The result would be simply a Government department acting in ignorance of industrial opinion as a whole and in no wise representative of it.

If the Government should create such a political Ministry, it would be rather an ornament to and recognition of industry than a practical assistant.

In Ireland, for instance, the Minister responsible for promoting the agricultural interests of the country has persistently opposed the policy of the *Irish Agricultural Organization Society*, organized by Sir Horace Plunkett. This co-operative body has accomplished much constructive work for the agricultural interests of Ireland, in spite of political opposition. But the fact that a Minister was appointed and a small grant given by the Government opened the way for petty, political intrigue. But the times are far too serious to play with problems in this way.

Those who blame the Government in this country for failures or mismanagement should blame themselves. If we are dissatisfied, our displeasure should be vented on ourselves; it is in our own hands to alter methods and conditions. The article elsewhere in this Journal on "Swiss Industrial and Commercial Organizations" illustrates what the people may do for themselves and for their country by co-operative initiative. The fact is, the Government needs to be led; it waits for direction from industrialists; it is a democratic Government in a democratic country, and it is not its function to initiate schemes which could not be carried into effect without the consent of the people. Democracies lose their meaning when they tie themselves up by state control; they limit development, stifle initiative and prepare for a reaction later on. It is a waste of time and energy to create forms as fixed as Government methods are bound to become. As a Government represents the union of a people in a political idea, so the individual Minister of a department must represent the collective decisions of the people engaged in the actual work of that department in Society. He is not necessarily a leader, he is their spokesman, a focus round which the people may act. In another sense, he is a chairman of a board of directors, and if he be appointed by them, with serious work in view, he will have their confidence and will not be regarded as holding merely a political post. The number of Government officials should be reduced, not increased. The officials of a State are symbols of the people's power; but the work and life-activities of the people must be carried on by themselves if they are to retain the interest in their operations that will keep them vital and progressive. In order to prosecute their own work the people appoint officials to police the country and the seas, to administer justice and carry out their enactments, and to act for them in international conferences. Those who are appointed as representatives of the Government abroad are trained for this purpose in international jurisprudence, and must understand the laws and customs of the country to which they are sent.

TRADE CONSULS.

There is a general demand that the Consular Service should become the "intelligence department" of our "industrial army." Have those who make this demand ever considered whether the industries are organized in such a way that they could make use of the information that they wish brought to their desks by government officials paid out of the general funds of the nation? What use do manufacturers make of the trade reports already issued by the Board of Trade? These reports may be inadequate, but they contain many suggestions that are never utilized; and valuable reports of certain British Commercial Attachés have never even been read by the large majority of our manufacturers. Those of Sir Francis Oppenheimer, for instance, told the whole story of German commercial aggression and pointed out the tendencies and weakness of their system. If British manufacturers had studied these reports with even one-tenth of the thought and care with which they were compiled, they would have understood what was required of them to preserve their markets and British prestige abroad. The Government may provide reports and information, but it cannot supply the intelligence required to assimilate them and act wisely upon them.

The Government of the United States has recently improved its consular service and is now spending more money in strengthening this service. The business men of America are proud of the consular reports that are issued almost daily from Washington. But, if you ask a representative of any firm in that country what practical use they make of these reports, his reply will be vague; the reports are filed away, and the firm proceeds along its usual course, either using its own channels of information as to new business, or simply taking what comes unsought without making special endeavours. Consular reports will not convert indolence into activity, no matter how promising the far-off fields of commerce are made to appear. On the other hand enterprising firms prefer to rely on the information that they receive directly through their own representatives, either individually or in association with others.

Commerce is indeed the basis of any nation's existence, but we are getting things out of proportion when we would say in effect that Great Britain exists in order to further the business of her traders. The function of commerce is to support the nation and to promote its ideals and traditions; but the

"State" or "Government" is simply a symbol of the collective intelligence of the people. Its representatives should therefore be the highest types and should represent the dignity, true culture and wide outlook which characterizes our most broadly educated men. They should not be mere specialists in any particular line, and appointed to promote particular interests.

The function of the British Consul abroad is not to push the interest of British subjects irrespective of the merits and character of the applicant. His influence should be used in favour of those whose reputation will enhance British integrity and credit. A trader should have clean hands before he claims the backing of Great Britain. The Consul should be a man who can open doors and bring influence to bear for all legitimate interest of British subjects abroad, and only a man of wide culture can wield such influence, or exercise discrimination as to the claims of those who go to him for assistance.

Industrial Associations should organize their own channels of information from foreign countries; the data will then be directly and rapidly obtained, and, through their own representatives on the spot, they will be able to take advantage of opportunities at once; if they wait for consular information, a firm of another nationality will secure it in the meantime. The German Consuls were successful in securing business for German firms because they acted as agents for these firms; their information was used where it was obtained; it was sent home and compiled into reports after it had been put into use. This arrangement was simply another case of the usurpation by the State of all the pursuits of the people. The Government officials had entered into a race for imperial power, and they used the people to their extreme capacity commercially and educationally. Every stream of life was converted into a race-mill to turn the wheels of the government machinery; and this machinery was not used to forge a civilization for the advantage of the world, or to provide opportunities for the development of great individuals amongst themselves. Who are the modern heroes in Germany? Industrial magnates, Krupp, Ratenau, von Bethman-Hollweg, Zeppelin, Helfferich! Organizers, inventors of military weapons, army men and any one else who exalted Germany as a powerful state! Who were their distinguished ambassadors abroad? Who have been their explorers and adventurers? Who, in these last years, were their great discoverers, their great inventors or philosophers? How they have forgotten Humboldt, Kant, Beethoven, Wagner and a host of others in the false glamour of Krupp, Zeppelin and the Kaiser! A magnificent example of what happens to a people when its symbol loses all inner significance and allies itself with the baser motives of men; when its consuls become merely commercial representatives and the higher intelligence of the people is left unrepresented!

There is, of course, no reason why a British Consul should not be a business man; given other qualifications, business experience should increase his usefulness. But commercial knowledge should not be the first nor only qualification. He should have the training in diplomacy and British standards of morality that characterize the discriminating and impartial decisions of our best jurists, if he is to represent the dignity of our great nation. A mere commercialist would be entirely out-classed in meeting the best types of men in other nations; his influence would be restricted and his standards of judgment would be limited by his narrow experience. A Consul confined to commercial details and interests is bound to lose his perspective and to lose also the standing he should have abroad as a representative of the British Government. The Commercial Consuls of Germany have not been held in particularly high esteem in foreign countries. They have, on the contrary, created the impression of a rapacious greed on the part of Germany.

British Traders complain that our Consuls cannot always supply them with statistics and trade information, and that German and American Consuls were often of more service to them in this respect. But it has not been the function of British representatives abroad to keep card-indices for British traders. It might be urged that the Consuls could employ a staff for this purpose, which would be easy enough; but it is doubtful whether enterprising manufacturers would be satisfied to accept data thus collected without verifying it for themselves. Special reports, such as some of the commercial agents of the U.S.A. Department of Commerce send to Washington, and such as

we receive from some of our Commercial Attachés, supply the most useful material for the consideration of manufacturers on which they may base their own conclusions. They cover a broad general field. They deal with the history of industrial organizations in other countries, and their relation to government departments; with general tendencies of industrial activities, the amount of the exchange of trade between different countries, the new industries and the needs of the country; and to repeat, we make very little use of what is already at our disposal.

The confusion in the popular mind at present with regard to the respective functions of officials and of different classes in the country is anomalous in the extreme. On the one hand we have an agitation for Democratic Control of the foreign office; on the other, a demand for a Minister of Commerce. "Business Management" is another by-word with those who think we have left too much to the lawyers!

When business men become lawyer-like in their decisions; when they can look beyond their own interest and decide an issue on its own merits, the country would, perhaps, get along very well under business management; but many business men have not the power to make disinterested judgments. We may have too many lawyers, but we may thank our national prevision for providing them at all. The unedifying proceedings that take place in the law courts are the by-products, as it were, of civilization and all classes contribute to them.

Lawyers with business experience are one of the most valuable classes in the community. When we have more business men with judicial training we shall be still better off.

Let us hear the conclusion of the whole matter; if we wish to preserve our Empire, we must not confuse the issues nor the functions of those who maintain it; and may we soon see the day when industrialists will realize their function in the State and co-operate to express it in a National Industrial Federation.

THE co-operation of all minds, each exercising its own particular powers, renews the Intelligence latent in the universe and available for each.

SWISS INDUSTRIAL AND COMMERCIAL ORGANIZATIONS.

Warring and chaotic Europe is not without an example of how a people may organize themselves industrially, unaided by the State. In the centre of the continent is a little republic, neutral in the present conflict, whose ensign is a white cross on a red field.

When the war broke out the industrial organizations of the several Cantons of Switzerland were ready for the emergency, and acted instantaneously to prevent unfair distribution of supplies and an inflation of the prices of necessary commodities. In the first days of the war, when Switzerland was absolutely cut off from the rest of Europe, when the mobilization of the armies of neighbouring States monopolized all railway traffic, when the tension of the financial situation was as yet unrelieved by Great Britain's declaration to redeem her paper with gold, when bankers with anxious sympathy and concern watched the people crowding to their doors—in those days, more portentous by reason of ignorance of the general situation, the decisions of the commercial and industrial bodies appeared regularly in the Swiss papers announcing their concerted plans for meeting the situation. The country was stunned and the simple bourgeoisie and keepers of shops and hotels were paralyzed by the unexpected advent of the catastrophe and the prospect of ruin to their business. But, in the lull occasioned by the cessation of communication with the rest of the world, those who had the management of affairs in their hands experienced no panic nor confusion, but entered immediately into conferences through the existing organizations. It was not necessary to wait for party politicians to act as industrial and trade associations were well organized throughout the country, and these were all united in a national body to protect the interests of the people of each locality and of the Republic.

The people of Switzerland manage and administer their affairs more directly than in any other country. Observant visitors who in pre-war days entered Switzerland for the first time, noticed at once on crossing the border the perfect management of railways and all public utilities. One felt that personal thought and attention were given to affairs and that, evidently, interest and pride were taken in their

administration, different in spirit from the obviously *regulated régime* in Germany, and, different also from the apparently careless, go-as-you-please and somewhat irresponsible, impulsive methods of French public services. Passing through France two years ago, on the way to Switzerland, the present writer was impressed with an atmosphere of neglect and lack of interest in the carrying on of facilities, as though the responsible persons were immersed in other matters, probably political issues; and, as a matter of fact, certain events in Paris at that time revealed a concentration in political intrigues which absorbed the energy of those charged with the management of the country. The advent of the war, however, changed the atmosphere in France, in a flash, and deeper concerns immediately united the people in effective action. This sudden transformation was apparent on returning through France in August, 1914, when the French army was mobilizing.

The contrast on entering Switzerland earlier in the year, however, was very great. There an air of freedom, of well-being and keen interest in the conduct of affairs was most pronounced. Someone is looking after things here, we reflected, as we settled in the little modern railway carriages, spic and span and fitted with the newest devices, to mention only one evidence of attention to details. Switzerland seemed a haven of peace, and a residence there did not dispel this first impression.

The people in Switzerland are the Government in a very real sense. It is a small country and government has not become divorced by politicians from the actual life of the people. State officials are really responsible to actual associations of the people, who advise and direct Government policies. To be a Swiss citizen is a matter of pride, and, wherever they go, citizens of this republic never give up their citizenship, even though they may also become subjects of other nations. Every Swiss is proud of the organization of the republic, and of the success which has attended the union of the Cantons, and, consequently, the affairs of the country are the practical concern of the citizens. The professional classes, the industrialists and the traders are citizens first, and private persons second. The population of Switzerland consists of several races and several different languages are spoken by the people who have united under a political idea which is their pride. This union has not been effected by conquest nor by State concessions; it is the result of the gradual, voluntary co-operation of the people in each Canton during many generations, until the final union of all the Cantons for their reciprocal interests was achieved.

The term "Chambers of Commerce" has no very stirring associations; in most countries their history is dull reading, and their achievements are not marked by imagination or special initiative. It is taken as a matter of course that the history of Chambers of Commerce should be dull, and a reader might perhaps remind us that commerce is not poetry or vaudeville or politics. How could it be a subject with "stirring associations?"

If the reader has himself imagination, he may see a hint of excitement and initiative and endeavour in the prosaic statement that the present Swiss Chamber of Commerce is *the executive organ* of the Swiss Commercial and Industrial Association, a body organized for common action when required and for the general interests of Swiss commerce, and composed of commercial and industrial organizations in every Canton, including representatives of government departments concerned with commerce.

The history of industrial, commercial and trade associations in Switzerland is of absorbing interest. A tendency to co-operate survived the disappearance of the old merchants' and artizan guilds, and in the seventeenth century Merchants' Directorates were very active "Chambers of Commerce," so to speak. They administered the postal system, regulated markets, inspected warehouses, controlled the traffic of goods and laws regarding bills of exchange, developed commercial courts, published newspapers, and promoted industrial enterprises.

With the general disorganization of European affairs at the opening of the nineteenth century, these Directorates disappeared, no doubt partly due to the fact that there was not sufficient inter-organization among them, as the Cantons themselves were still unfederated.

During the early part of the nineteenth century, bodies representative of commercial interests assumed various forms, owing to spasmodic and sporadic agitations. The resort was usually to an Official Commission, the

members of which were prominent merchants appointed by the Cantonal Governments, and their scope was limited to advisory functions. Only one organization, that of St. Gall, retained its former power, " developed an independent activity and was able to do important work. It carried on negotiations with foreign Governments relating to its industries and introduced textile machinery from England."

The new Federal legislation of 1848 established the freedom of commerce and trade amongst the Cantons, and so reduced the importance of these local Official Commissions, and their special privileges were automatically annulled. In any case they were not equipped to meet the rapid industrial development that followed throughout the country, and neither were the Federal authorities.

METHOD OF ORGANIZATION.

Business circles began to feel the need of organization, and gradually voluntary associations of merchants and manufacturers of special industries were formed, also voluntary and independent organizations of business men in particular districts. Within a few years the members of these various bodies saw that a central bond was necessary and in 1869* it was suggested that the merchants and manufacturers of the entire Swiss Federation should combine into an association for the furtherance of their common interests. All commercial and industrial associations in every Swiss Canton, all Chambers of Commerce in Switzerland, and the State Authorities in those Cantons without commercial organizations, were invited to send representatives to a meeting in Berne to discuss ways and means to carry out the principal object, which was *to aid the administrative departments in an advisory capacity.* The business men of the country realized that the Government needed advice and assistance, and that *they* were the proper persons to give it ; if it is not hitting the nail too obviously, it might be added also that the business men of Switzerland were not expecting initiative from the Administration.

" In *March*, 1870, a second meeting was held and an association was formed under the name of the Swiss Commercial and Industrial Association. Fourteen voluntary associations, five local official commercial departments, and two trade associations joined the organization *as sections*. The management of the affairs of the Association was placed in the hands of the Commercial and Industrial Association of Berne, and a committee of seven members was appointed for the preliminary discussion of subjects to be taken up at annual meetings. Every succeeding two years another section of the Association was charged with the management of its affairs.

" In 1878 the Commercial Association of Zürich took over the direction of the affairs of the Association. It was found desirable to make the arrangement a permanent one. A permanent secretary of the Association was appointed. In 1881 the board of management was greatly increased by an addition of members and greater permanence was secured by extending the term of office of the board to four years. The Commercial Association of Zürich has ever since been the home of the Swiss Commercial and Industrial Association."†

There are now about sixty-five members.

" The Executive Board is elected every four years at the meeting of delegates and consists as a rule of the Executive officers of some one Section. It represents the Association before the Government, passes on all material submitted by the individual organizations and prepares the annual report.

" The delegates of the Association choose fifteen of the nineteen members of *The Swiss Chamber of Commerce* and the executive board appoints four. The presiding officers of the executive board preside also over the sessions of *The Swiss Chamber of Commerce*, which organization mediates between the executive board and the meeting of delegates, and is charged with co-operation in all matters of importance or of general interest to Swiss commerce."†

It was " particularly prominent in connection with the promulgation of the last Swiss Tariff, one of its principal functions being to aid the Government in reconciling conflicting interests in connection with the customs tariff."

* In the same year the Associated Chambers of Commerce in the United Kingdom requested the British Government to appoint a Ministry of Commerce, and they have been repeating the request periodically ever since. In Switzerland the Chambers of Commerce joined with industrial organizations and formed their own " Ministry of Commerce."

† *Commercial Organizations in Switzerland.* Archibald J. Wolfe, Commercial Agent of the Dept. of Commerce, Washington, U.S.A.

SERVICES.

"The Association has done effective work, particularly in matters of transportation, customs, tariffs, negotiation of commercial treaties, exposition affairs, etc. The Swiss Federal authorities not only consult the Association in all matters strictly within its sphere, but submit also such matters as consular appointments for its approval. Its reports on Swiss commerce and trade are lucid and exhaustive."

WORK OF INDIVIDUAL ORGANIZATIONS.

The organization of this national body did not lessen the activities of local chambers of commerce, or of the associations of particular industries who joined the federation. Rather it stimulated their activities, as none of them renounced their individual independence. Those Chambers of Commerce organized by business people of their own accord, and not under State auspices, have freedom from legislative regulation; they are really evolutions of the old commercial directorates and develop in accordance with their initiative, energy and needs. They are "frequently consulted by the Federal and Cantonal councils in connection with proposed legislation affecting patents and trademarks, national banking, employers' liability, the apprenticeship system, transportation and postal, telegraph and telephone regulations. The time-tables of Swiss railways are regularly submitted to the Chambers of Commerce for approval." * The Chambers of Commerce have also assisted in the introduction of new industries into Switzerland, and have helped several industries over periods of temporary depression.

Trade schools and continuation schools for apprentices in various industries are encouraged by the Chambers of Commerce. The famous St. Gall Chamber maintains a school of applied designing of its own, also a savings bank for employees, and commercial and industrial museums. Most Chambers have reading rooms and libraries.

The three principal Chambers of Commerce act as mediators between employers and employees, and also between Swiss exporters and foreign buyers.

This very brief comment on the work and organization of Swiss industrial and commercial bodies does not permit a description of many others that are doing important work.

The Swiss Federal Department of Commerce was re-organized in 1913, stimulated by the activities of the unofficial bodies, and the Commercial and Political Departments of the State were united in an "Economic" Department, with sections also for Health, Social Insurance and Agriculture. It had become evident that, Switzerland being a small country, commercial relations with foreign countries were equally, if not more, important than purely political matters, and should be recognised as such by the Federal Authorities.

ORGANIZATION OF CRAFTS AND TRADES

The Government is also assisted by expert opinion on subjects relating to the interests of artisans and tradesmen by a Central Organization of Tradesmen's Associations, which was modelled on the Swiss Commercial and Industrial Association, and founded in the interests of crafts and trades, and for artisans and master-tradesmen carrying on manual trades in independent shops. It maintains a permanent secretary and has an annual subsidy from the Federal Government. It provides courses of lectures and actively promotes a spirit of co-operation in local associations.

The ground is, therefore, well prepared in Switzerland for a still more comprehensive federation, including educational bodies, workmen's associations and the National Industrial Organization already described.

NATIONAL consolidation alone will not secure the future; it may mean, indeed, but the death of a civilization. Scientific knowledge and skilful organization may be allied to motives which will destroy a civilization after it has been constructed. For it is not by knowledge alone that progress is made, but by the right use of knowledge, and this depends on the motive that prompts to action.

* Ibid.

COMMITTEE MEN: THE MEN BEHIND THE GUN.

The real effectiveness of any association or organization depends very largely upon the work done by its committees during the year. In the B.E.A.M.A., for instance, each Section has a committee that meets regularly to confer on matters concerning the special industry of the firms in the Section. Few realize the arduous work of these committees, the tedious details, the patience, the co-operative spirit and self-control that are involved. The results are boiled down into more or less short summaries in a form which the members can accept, but which seldom shows the amount of labour involved.

Other committees, representing the Association as a whole, hold consultations with committees of several bodies concerned with Electrical Development, and in *The Annual Report* we read that such and such a question has been satisfactorily settled, or a forward step has been taken in the development of community of interest amongst those connected with the Electrical Industry. To estimate the amount of energy thus expended in brain power, in experience, in good-will—all for the general good—would be impossible. The following, from *The Electrical World*, New York, is *à propos* :—

"Each year closes upon results of the work of scores of committees of the various electrical organizations. Hundreds of men and dozens of companies have devoted time and money to advance the industry without direct benefit to themselves. Oftentimes the work is arduous and exacting. Generally it is thankless. Occasionally the work itself is performed by one group or one individual and is credited to others because of organization routine. It is not possible to enroll publicly the names of all these men. Yet no summary of any year's work is justly made without recognition of the spirit of service which prompts the majority of those who carry on the detail of organization activities. In the hands of meetings, papers, policy and finance committees, to mention only four, lies the final success of organization work. When a great leader dies the wheels of industry stop for five minutes in his honour. It is worth while for once a year to halt the thought of the industry and to point to the men doing committee work. What they have done and what their successors will do fixes in general the runways of tremendous forces for our technical, engineering and commercial progress."

A POLICY FOR THE FUTURE OF BRITISH INDUSTRY. By A. W. KIRKALDY, M.A., B.Litt., President Economic and Statistical Section of the British Association.

As to the need for harmonious relations between all ranks of our industrial army, there should be but one opinion. Even in normal times employers and employed should work together with a minimum of friction if they are to enjoy the best results from their common efforts. Unfortunately, however, a survey of our industrial life during the past few years shows that in certain important industries there has existed almost a maximum of friction.

How has this state of affairs arisen, can it be improved ? The object of this paper is to try to throw some light on the subject, and to make some suggestions for the reader to weigh and consider.

The industrial revolution, which resulted from the application of steam power and machinery to manufactures, opened up an entirely new situation in industrial life. The cottage industry system under which so many of our manufactures had been previously carried on came to an end, and the manufacturing town, with its factories and slums, became an integral part of our social conditions. As chief among many new phenomena there appeared an accentuation of the difference between riches and poverty. Hitherto with a comparatively scattered population, this difference, though existing, had not obtruded itself so blatantly.

Hence about the beginning of the nineteenth century philanthropists and economists began to give attention to the new conditions of living which were appearing in consequence of changed circumstances. The economist wanted to know more about the wealth now being produced in largely increased amounts. The enquiry should naturally have been extended into a consideration of its distribution and consumption. Unfortunately, writers and thinkers on economics, having defined wealth, gave their best attention to its production, and their theories were developed and put into practice by politicians and manufacturers, who became known as the Manchester School.

Everything must give way to production. Any obstacle in the way of increasing the

output of mill, factory and mine was anathema, and must not be tolerated.

There were no precedents to go upon and keep public opinion sane, for the conditions were entirely new and untried. The result is well known. In the rush to be rich, both individually and nationally, the whole country gave itself up to killing the goose that could lay golden eggs. In other words, the labour force was to be recruited from every possible sphere, every available man, woman and even child was to be rallied to the cause. The labour force was to be strained by every device, and at any sacrifice so as to make its productivity the utmost possible.

Labour itself became tainted with the same delusion, hence early marriages and large families were the desire of both working men and women, so that at a tender age every child might become a factory hand and help to fill the family purse. Almost the whole country appeared to be demented on the subject of producing the greatest possible amount, regardless of what the cost to life and health might be. All Europe became envious of the growing wealth of this country, little knowing the true state of the case.

The condition of the workers went from bad to worse, and labour itself in spite of its disadvantages began working out a policy of self-help. This has given us the Trade Union movement, a system of organized labour which, on the whole, has proved to be the best method for enabling labour to make just terms with capital. But some middle-class observers also, deeming that labour could not help itself, and mistrusting what was going on during the early days of the change, began to formulate schemes of reform. In aim these men were at one, their policy varied. On the one hand there was a healthy desire to ameliorate the sad conditions under which so many workers were living; on the other, there arose a school of reformers, who, noting the error made by some economists of concentrating on production, and how to increase it, fell into the opposite error of giving their attention almost entirely to the question of distribution, or how to get a greater share of what was produced for the artizan class. From this school has evolved modern socialism, whose great and patent defect is attending mainly to distribution, failing to realize that there must be production before there can be distribution, and that in order to have a healthy industrial community, you must give attention to a temperate consumption of what has been rightly produced and wisely distributed.

Unfortunately, side by side with the effort to get for manual labour a greater share in what it helps to produce, there has appeared in a new form that old enemy to national progress—class warfare. For the Socialist, when the franchise was broadened, saw the political advantage to be gained by having a hold over labour. Thus labour has been, and is being taught that the capitalist is its enemy, that the employer's object is to take all that he can get under a system of relentless competition. In many instances, unhappily, colour is given to this teaching, for some employers have made use of a policy which takes the form of "speeding up," and this "speeding up" finds its corollary on the labour side in "ca' canny" and restrictions as to employment and output.

In a short article it is not possible to go over the whole of the effects of these reprehensible practices. Both the employer and the workman adopting and practising them are to blame. The main effects are patent to every intelligent person. There is continuous and often ruinous loss to both the individual and to the community. The employer equips a factory at great cost with up-to-date machinery. That machinery is not allowed to do its full work, indeed in some instances it is asserted that the output could be trebled without causing undue strain or injury to the operative. This is not only a loss to the employer, but the wide practice of such tactics increases the cost of production all round, and hence the general public suffer because prices are artificially high. Higher prices entail smaller demand, and you get into a vicious economic circle, wherein wages, profits and national wealth all suffer.

Apply this to the present situation and its possible developments. As is very widely known, our success in the war against Germany and her allies depends to a great extent on the output of our industries. We need guns, ammunition and equipment for our own and our Allies' forces in undreamed of quantities. At the same time we must maintain, so far as is possible, our internal and external trade, for the war depends on gold and silver as well as on leaden bullets. Every section of the industrial and commercial community is, therefore, called

upon to show that he realizes the sacrifices made by those fighting at the front, and that he is willing to strain every nerve to do his part in winning the war. Happily the nation as a whole has responded to the call. With the departure of troops to the front there appeared an unexpected spirit of conciliation amongst employers and employed. With the object of increasing the output of munitions, restrictions on all sides were removed, and both capital and labour were for the period of the war given practically a free hand to do their utmost. The immediate prospect is satisfactory—but what is to be the situation when the war ends? Are we going back to pre-war conditions, a restricted output, together with a striving after higher wages by the men, and a stubborn refusal to listen to any demand, so long as it is possible, on the part of the employers? If so, the victory over the Central Powers will not benefit us to any great extent.

What are likely to be the conditions in the business world when peace comes? It is not easy to foretell, but one can attempt a forecast that may help to prepare the country for what is coming. So far as Europe is concerned, it would seem that only two countries are likely to be in a position to compete for some time in the world's markets. Those two countries are England and Germany. England, except for the very trifling damage worked by Zeppelins, enjoys her manufacturing and commercial advantages intact. Germany seems unlikely to suffer from the horrors of invasion on a large scale. She will have to hand back Belgium, north-western France and Russian Poland to their previous owners. She has, however, stripped these great manufacturing districts of their equipment, and even, in some instances, of their railways, and it will take years to build up what she has wrecked. But Germany has probably ruined her banking and credit system, though it remains to be proved how far the ruin is irreparable. The German mark has depreciated, and may be expected to remain in a state of depreciation for some little time. It should be noted, however, that whilst a collapse of the banking system would undoubtedly prove detrimental to foreign trade, the depreciation of the mark will, so long as it continues, be rather an advantage to export trade, and should prove of material assistance to Germany in regaining her place as a world trader.

In England we have maintained our banking and credit system practically unimpaired, and this fact will be of capital importance when peace dawns. The real crux of the position will be the attitude of labour. Here, unless one is greatly at fault, Germany may have a considerable advantage over England.

During the war many of our employers, and most of our workpeople, have been enjoying inflated profits and wages. Our labour force, including many women, has been earning a rate of wages never previously gained.

Without accepting the darkest pictures of the condition of Germany, there can be but little doubt that nearly every section of the community has been feeling the pinch. Germany, if beaten, will be a poor country. She will yearn after the flesh pots of the past. She will endeavour to regain her old hold on foreign markets. And from several points of view she will enjoy advantages in the cut-throat competition that may be expected to follow the war. The economic condition of Germany will probably be deplorable, but hardly irreparable. And a disciplined people under an autocratic government will set its teeth to the great task confronting it. The workers will be ready to accept starvation wages, the employers will be equally prepared to work for very bare profits, whilst the Government will do its utmost to foster trade, especially the export of manufactured goods. For this purpose railway rates will be cut to the lowest possible figure on all goods for shipment; the canals, too, will offer special facilities, and so far as it is possible, the shipping industry will be assisted with bounties.

If this forecast prove true, what can we do to bring about a state of affairs that will enable us to prevent Germany from not only regaining her previous markets, but from extending her trading connections at our expense?

We shall commence with some solid advantages, but these by themselves would be unavailing. Fortunately the war itself, with all its horrors, has worked some remarkable changes, which must prove beneficial to our future well-being. As a people we have fought for a great cause, and the efforts we have made have had an ennobling effect. Four millions of the finest of our manhood have submitted to

military discipline, and have served side by side in the trenches. These men represent all classes, including both employers and employed. They have learned to know each other in a stern school. The effect of this alone on industrial relations in this country will undoubtedly be very far-reaching. All grades of the working force will view things from a very different standpoint. The old game of grab should no longer appeal to either party as it did.

Not only will our labour force be radically modified, but the disbanded soldiers will come back to different working conditions. At great expense new factories have been built to modern plans, and equipped with the most recent machinery. It is said that the American workman has been producing nearly three times the amount of the ordinary Englishman. The explanation of this is not that the American is the better man, but that he works with better tools and possibly under a more scientifically organized system. We have been somewhat slow in discarding old methods, but in this we are changing rapidly. The advantage of shop and equipment will rather be on our side. Many new phenomena will, therefore, have to be taken into consideration when one tries to forecast industrial and commercial happenings during the next decade.

How can we formulate a policy which may be calculated to give us an advantage over a competitor spurred on as we have seen that Germany will be? The subject has for some time been attracting public attention, and among the schemes put forward is that of a fiscal alliance amongst the entente nations, entailing a boycott of German goods and ships. Superficially it would appear to be a fairly simple solution—but is it practicable? One would gladly see Germany punished in some such way for her brutality in this war. Her treatment of Belgium, north-western France, Poland and Serbia calls aloud for condign punishment. But one fears that Germany will never be adequately punished by a commercial policy. The memory of the blackest deeds is apt to be short-lived, whilst cheapness appeals to every pocket; nor will the neutral markets be greatly influenced by the brutal war methods of the Central Powers.

By all means let us cement the political entente by a trading allinace, but we shall be foolish indeed if we rely wholly on that. What is needed, in order that we may as a people be prepared for the situation that the coming of peace will create, is that our ablest men shall here and now, making use of every advantage for obtaining the necessary information, draw up a careful forecast as to what will be the industrial and commercial possibilities when the war ends. When the picture is complete, and has been tested in every detail, let the trusted representatives of employers and workmen meet and discuss the whole situation. War wages and war profits will no longer rule. It may be that a very bare living will be available for a time. Let each side say how it is prepared to act. If possible, let some percentage of gross trading results be apportioned to each factor in production. The employers should be absolutely frank, no information that labour is entitled to know should be withheld. Each side should make a point of winning the confidence of the other. Could this be done the future need cause us but small anxiety.

I have referred to new working conditions resulting from the war, new factories and equipment having been necessitated by the needs of the Allies. Yes, it may be said, but certain arrangements are only to hold good during the war. That, indeed, was the agreement when Trade Union restrictions and Government regulations were put in abeyance. Why were these rules set aside? Because they hampered output, and our success in the war depended on producing the greatest possible amount of munitions. *Our commercial success will now equally depend on the productivity of mine, mill and workshop.* Are we going to restore hampering restrictions just at the critical moment? The Trade Unionist may say that it must be so, as otherwise labour will be unfairly treated. Is there no alternative? Happily there is. If capital and labour would cease to believe that class war is a necessity, if they could agree to work together in harmony, for the benefit of both, our trade would enter upon a new era of prosperity.

We have something to learn from other nations. Germany has shown the advantages to be reaped from an extended application of scientific research to manufacturing industries. America also has a lesson for us. In that country the principles of scientific business management have been studied and practised with marked success. In one instance,

quoted in a recent book on the the subject,[1] by studying the effects of fatigue and how to minimize it, labourers were enabled to increase the amount of pig-iron handled per man from 12½ tons to 47 tons a day. And it is stated that at least 50,000 workmen in the States, working under the new system, are receiving from 30 to 100% higher wages, whilst the companies employing them were never so prosperous. This shows a wisely-organized system of "speeding up." The men are not over-worked, and yet get through a greatly increased amount of work. Both sides benefit—the workers by earning considerably higher wages; the employers, through having a contented labour force, and increased production. This new development in industry requires our very careful attention.

The future of industrial England depends on developing a thoroughly well-orgainzed system, wherein capital and labour, both in turn efficiently organized, and each with the requisite knowledge, may work harmoniously together for not only their own benefit, but to the advantage of the whole Empire.

THE only escape from dulness is creative work. But creation is always epigenetic; it is not a rearrangement of materials; it begins at the source of life, from whence flow all ideas. In men the source is Intelligence. If we had sufficient of this we should set to work to understand its laws and to put them into operation. We should clear the decks of prejudices and dry bones of the past, and meet together to devise ways and means to further social development and the high ideals of our race.

---

[1] *The Principles of Scientific Management*, by F. W. Taylor (p. 28).

ELECTRICITY IN ITALY. By LIEUT. F. E. M. THRUPP.

Up to now, our electrical industry as a whole has neglected the Continental market; the opportunity which we now have of making up for lost time should therefore not be overlooked. Italy is undoubtedly one of the countries offering the best prospects of success. Under the circumstances, the following data which I have collected while recently revisiting the country may prove interesting.

In our endeavour to export electrical material to Italy we shall, of course, find ourselves up against Germany. It would be unwise to place too much reliance on the obstacles which the patriotism of our Allies will put in Germany's way. In the first place, Italy is not at war with Germany. Secondly, "business is business" and the stress of competition is a powerful incentive to order cheap goods. It is to be hoped that the Government by drawing up a suitable import tariff or by any other means which may be suggested at the Paris Conference will spare Italian buyers this dilemma; but in any case we must not lose sight of the fact that Germany is at present accumulating large stocks of goods which she will be able to sell abroad at low prices, as soon as the war is over; nor must we forget that Germany's mercantile fleet is lying idle in German and neutral ports, that it is not being subjected to the wear and tear our ships have to endure, and that consequently, she will have a large number of ships in good condition available for trade at the close of hostilities, when we shall be busy repairing our own.

A strong committee of Italian electrical engineers has been formed with the object of bringing pressure to bear on the Government to ensure its taking the electrical industry into account when the tariff question is under consideration. As Italy's commercial treaty with Germany expires in 1918 Italy will be able to shape her economic destinies in concert with the Allied Powers, even though she is not at war with Germany.

SOURCES OF POWER.

Italy has to import all her coal, only lignite of low calorific value (600,000 tons per annum before the war, now somewhat more) is to be found in the country. The

present price of English coal is about 200 lire* per ton as against 30 before the war. These two facts have shown in what a critical position Italian industries can find themselves in time of war through lack of fuel, even though nine-tenths of the imported coal comes from an allied country. It is therefore not surprising that great efforts are now being made to promote a better utilization of Italy's own resources in the shape of water power, especially as it is doubtful whether the price of coal will return to its former level when the war is over. The Government has granted special facilities, such as the immediate entry into possession of land required for extensions, new transmission lines, etc., on the part of existing or new supply companies, as soon as the local prefect's sanction of the scheme has been obtained, instead of waiting as heretofore, for a declaration of public utility and an agreement regarding the price to be paid. This matter can be settled later, either by mutual consent or by a decision of the judicial authorities.

Two million h.p. could easily be obtained by harnessing only the most accessible sources in the country. At present approximately one million h.p. are produced in this way, and about two-thirds of this power is converted into electricity. The harnessing for electric purposes of another half million h.p. (which I calculate could be utilized) would require some capital, but as Italians will probably find it difficult to raise it, British capitalists would be well advised to look into this matter.

The large Italian hydro-electric supply companies are exceedingly well managed; they have consistently paid good dividends without neglecting depreciation and reserve funds. They find no difficulty in disposing of current, and could, in practically every case extend their business if they had the means. The *Imprese Elettriche Conti* which is one of the most important, sells current to a score of subsidiary supply companies and municipal bodies. It has a capital, including debenture stock and reserve fund, of about 40 million lire, and sells 200 million units per annum. A dividend of 8 per cent. has been paid for years. This company is seriously considering an increase of capital, and the same applies to another important supply company, the *Società Elettrica della Sicilia Orientale*, and to several others. There is also a scheme afoot for harnessing an important source of power in Calabria where, with a capital of 25 million lire, 120,000 kw., will be available, costing only 60 to 70 lire per kw.-year. This power will be used in large electro-chemical works and for general supply in an extended area. The prospects of the scheme are very good.

ELECTRIC RAILWAYS.

The electrification of railways also offers excellent scope for British manufacturers, experience having shown that a considerable saving is effected by the application of electric traction on all mountainous lines having much traffic. Several important lines are working with success on the three-phase system (16 to 17 periods, 4,000 volts overhead line and motor pressure), speeds such as 47 miles an hour being easily kept up with heavy trains on gradients of 1 in 28.

The state railway authorities pin their faith on the three-phase system, for which they have standardized nearly all the material required, but some of the leading engineers in the country hold that the future belongs to the high-pressure direct-current system, and it may be expected that this latter system will be given a trial on lines crossing the Apennines; the simplified construction consisting at the most of only one overhead wire and freedom from inductive disturbances in neighbouring telegraph and telepohne systems being advantages which cannot be passed over.

Experience extending over several years has shown that the same effective work is obtainable from 1·25 units costing 2½ centimes as from 3 kilos† of coal costing, before the war, 9 centimes. In addition to the above saving, which is partly due to locomotives feeding back into the line when trains are descending gradients, there is much less wear on rails and wheel rims.

Whenever possible the Italian State Railways purchase the current consumed on their electric lines in preference to generating it themselves. Line construction and locomotives are invariably made to the specifications of the State Railways; these specifications go into all possible details, including the quality of the raw

* £1 sterling = 25·60 lire, is the normal peace-time rate of exchange.

† 1 kilo = 2·2 lbs. approx.

materials to be used, and provide for the supervision of manufacture at maker's works. Locomotives are used in nearly all cases, as electrification has only been adopted on certain portions of lines over which made-up through-trains have to travel.

Up to the present the Italian Westinghouse Company, the Italian Brown-Boveri Company and the Swiss firm Oerlikon have supplied nearly all the electric locomotives; the former company builds them entirely in its works, while the latter two firms work in conjunction with the two Italian firms, Brera and Saronno respectively for the mechanical portions of the locomotives.

FINANCIAL ASSISTANCE.

All these projected schemes will involve the installation of a good deal of electric plant, and it is admitted that Italian makers will be unable to manufacture it all. Obviously the entry of British manufacturers on the Italian market would be greatly facilitated by the financial participation of British capitalists. There are several ways in which this could be done; the one which seems best suited would be for a British Syndicate to be formed which would provide capital for extensions to existing schemes, for the formation of new companies and for the electrification of railways, etc.

The influence which some such syndicates would obtain would greatly benefit British industries. It would not be able to compel Italians to order all their plant in Great Britain (these German methods are now unveiled and are, besides, distasteful to Britishers who do not aspire to a commercial domination of the world), but all the plant which cannot be provided in Italy would naturally be obtained in the British Isles.

The syndicate would have its representatives on the boards of companies in which it had invested. The capital with which it could commence operations might be £500,000 to £1,000,000. Such a syndicate, if well managed, would popularize electric investments in this country to the lasting advantage of our electrical industries.

GOVERNMENT CONTRACTS.

The Italian Government has quite recently authorized the State Railways to devote the saving which calculation shows is obtainable on certain lines by the conversion from steam to electric traction to the payment of yearly subsidies to such contractors as obtain the concessions for carrying out the work of electrification. This method is largely resorted to for public works concessions in Italy, and enables the state to have costly schemes carried out without providing the means in a lump sum. The subsidy is, of course, in each case calculated in such a way that the holder of the concession is repaid when it is stopped at the end of the pre-arranged period, which may be anything from thirty to ninety-nine years, the work then becoming the entire property of the State.

It is not necessary for the applicant of the concession to be in possession of the capital required; he merely sends in his project, which is examined by the *Genio Civile*; if it is found technically suitable and the applicant seems able to undertake the work he is granted the concession. The time within which the work has to be completed is of course specified.

The holder of the concession then has to find the capital to carry out the work, and he usually obtains it from one of the larger banks. The *Banca Commerciale Italiana* had, practically speaking, the monopoly in this kind of business. It provided the funds and had the right to the Government subsidy transferred to itself.

In the case of municipal supply systems the practice is for the Municipality to have a scheme worked out, to call for tenders, to send them to the *Genio Civile* for approval, and finally to approach the *Cassa di Depositi e Prestiti*, which is a Government institution issuing loans to local authorities at a low rate of interest. In these cases the contractor comes into some of his money when the work is finished, and passed by the *Genio Civile*; it is not the custom to make payments on the arrival of material.

INDUSTRIAL BANKING.

The *Banca Commerciale Italiana* mentioned above is considered to have been the agent by means of which German commercial and industrial penetration into Italy was effected. It was originally formed with capital which was mostly German, and

of course the principal appointments and the leading members of the board of directors were Germans. Little by little the German shareholders sold out, and at the beginning of the war only about ten million lire out of a capital of 180 million were held in Germany, but the policy of the bank had continued to be dictated by Germans. The other shareholders, being satisfied with their dividends, never troubled to enquire deeply into the way in which the bank was managed, and although the German directors were actually numerically in the minority their influence and standing were such that the carefully selected majority of non-Germans was powerless to oppose them and indeed never attempted to do so.

The hold of this bank on Italian industry and commerce cannot be exaggerated. It was practically necessary for merchants and industrials to do their business through it. The influence which this state of things gave it over its clients can easily be imagined, and it is unnecessary to dwell on the uses to which such influence can be put. If one considers the fact that Italian law permits banks who are in possession of shares as securities for loans, debts, etc., to attend shareholders' meetings and to vote accordingly, and that the practice of borrowing shares for a consideration at the time of ordinary shareholders' meetings is by no means unknown in Italy, if one considers these conditions one cannot marvel at seeing Italy drift into a state of economic vassalage to Germany.

The danger of having practically all their commercial and industrial business dealt with by one single bank is now realized by Italians and such banks as the *Credito Italiano* and the new banking combination going by the name of *Banca Italiana di Sconto* will probably benefit by it. British banks have unfortunately always fought shy of Italy; perhaps in view of altered conditions they will now reconsider their attitude.*

GERMAN TRADE WITH ITALY.

Nearly one quarter of Italy's imports (3,645 million lire in 1913) came from Germany and Austria-Hungary. Germany alone exported goods to the value of 612,000,000 lire to Italy in that year; of this roughly 38 per cent. were raw materials, 19 per cent. plant and other goods required for building construction, etc., and the remaining 43 per cent. were goods for direct consumption and sale to the public. Next to Germany Great Britain exported the largest amount to Italy, and figures at 592,000,000 lire, of which, however, 331,000,000 lire or 56 per cent. were for coal alone.

The enormous sum annually expended by Italy on foreign coal materially swells her adverse trade balance of 1,134,000,000 lire; it is therefore natural that a better utilization of her own "white coal" should be insisted on.

Germany has always considered Italy as a dumping ground for her manufactures. By increasing their turnover German manufacturers were able to reduce the apportionment of establishment expenses of each article, and it paid them to sell cheaply abroad for this purpose, a high protective tariff, of course, allowing them to sell at a remunerative price within their own borders. One of the factors which made this possible was the bonus and low rail freights allowed by the Government on all goods exported. The money thus directly and indirectly expended by the Government was in the nature of an investment, as it ensured factories being kept busy and labour prospering, and thereby increased its returns in taxes. It was nevertheless an investment requiring capital, and it may be doubted if she will again be able to indulge in it after the war.

THE ITALIAN ELECTRICAL INDUSTRY.

The large German electrical combines never allowed Italian manufacturers of electrical machinery to prosper. Several well-managed purely Italian companies were formed in Italy and desperate efforts were made by them to resist the pressure of German competition; they amalgamated with one another, but eventually had to allow themselves to be absorbed by foreign firms. It is important to note that at that time (1902 to 1906) Italian customs tariffs were framed in such a manner as to give foreign manufacturers an advantage, because of the high rate of duty on the raw materials which Italian manufacturers have to import. For instance, the duty on the raw materials going to the making of transformers was about 28 lire per 100 kilos, whereas the duty on the finished article was only 25 lire per 100 kilos.

* Since writing the above the formation of an Anglo-Italian Banking Corporation, under the auspices of the London, County and Westminster Bank, Lloyd's Bank aad the *Credito Italiano* has been announced.

In 1906, however, the duty on sheet iron* was withdrawn, but it was too late. At the present moment electrical machines weighing less than one ton have to pay an import duty of 25 lire per 100 kilos, also transformers and accessories; this is reduced to 16 lire in the case of machines weighing over one ton. In comparison with the tariffs obtaining in other continental countries this rate is very low, as the following table will show:—

IMPORT DUTY INTO VARIOUS COUNTRIES IN BRITISH CURRENCY

On the following plant —	Austria-Hungary.	France.	Spain.	Russia by Sea.	Italy.
·75 kw. 3-ph. motor weighing 98 lbs.	14/6	27/5	34/6	47/0	8/8
75 kw. 3-ph. motor weighing 2,450 lbs.	244/8	172/7	431/5	1184/4	138/0
100 kva transformer weighing 1,225 lbs.	120/0	129/5	215/8	595/3	107/6

In consequence of the removal of the duty on sheet iron the average duty paid on the raw material required to build machines is now: 20 lire per 100 kilos for transformers, and 10 to 12 lire per 100 kilos for motors and generators.

It will be seen that these figures are below the duty on the finished product.

In 1913 Germany exported to Italy 13,700 tons of boilers and machines and parts for same, whereas Great Britain's corresponding figure was only 3,600 tons. Of the above German exports to Italy 2,500 tons were electric machines, mostly weighing over half a ton. Italy produces most of her own requirements in small electric machines; in fact one of her factories, Marelli & Co., exports small motors in considerable quantities, even to Germany, the Italian customs refunding to the manufucturer the duty he has paid on raw materials used in making machines which are exported. Germany also exported to Italy 1,200 tons of electrical apparatus, 900 tons of insulators, 400 tons of measuring instruments, 120 tons of telephone apparatus, 150 tons of metal filament lamps, equivalent to about 3½ million lamps (Italy's total imports of metal filament lamps is about 10 million pieces per annum).

It is computed that Italy produces nearly two-thirds of her requirements in electrical goods, but her most important factories are under foreign control.

* For stampings.

The Italian A.E.G. Company, for instance, had a turnover of 15 million lire, but only about three million lire worth of material was constructed in the Italian works; the bulk of the rest came from Germany. This concern has now changed its name and is called *Società Elettrotecnica Galileo Ferraris.* It has dismissed its German directors and now works in conjunction with the G.E.C. of America. The Italian Brown Boveri Company has large works in Italy and turns over 10 to 12 million lire per annum. It is believed that most of the capital of this Company is in Italian hands, but it is in the main controlled by the Swiss parent company which in its turn is not supposed to be free from German influence. The British Westinghouse Company controls an Italian subsidiary company having its works at Vado near Genoa. There are two excellent Italian firms making high and low-tension switchgear and good accumulators are also made in Italy, but there is a good opening for British-made meters, switchboard and laboratory instruments, insulators, installation material, metal filament lamps and materials for ships' installations. As regards electrical machinery the demand ought to be very large, even before the end of the war, especially if capital can be found to extend existing hydro-electric power schemes and thus incidentally to facilitate the installation of electric motors in the place of many existing steam and internal combustion engines.

DISTRIBUTION OF MOTIVE POWER.

The total output of all stationary prime movers in Italy is now reckoned at over two million h.p., but 1911 is the last year in which a census was taken, and at that time there were 1,620,000 h.p., of which 59 per cent. were obtained from water power, 29 per cent. from steam engines and 12 per cent. from internal combustion engines. Of the harnessed water power 72 per cent. was converted into electricity, and in the case of steam and internal combustion engines the corresponding figures were 47 per cent. and 34 per cent. respectively. This leaves approximately 376,000 h.p. produced by steam and internal combustion engines which are not converted into electricity. It is safe to assume that out of these about 250,000 h.p. could be more economically produced by electric motors

deriving current from water power stations. Allowing for the power which chemical fertilizer factories and other new large concerns would absorb and for the demand from electrified railways, one easily arrives at the figure of the additional half million h.p. mentioned before as being capable of being utilized. Electric motors installed in Italy run to about 580,000 h.p., and about 300,000 kw. are consumed for lighting. The total number of units generated in 1914 was 2,500 millions.

In order to give an idea of Italy's industrial development I would mention that about £160,000,000 are invested in her industries, that the annual production of her chemical industry is valued at £7,000,000, that she has about 5,000,000 spindles working in her cotton mills, that she produces 350,000 tons of sulphur per annum, 400,000 tons of cast iron and 800,000 tons of steel.

REPRESENTATION OF BRITISH MANUFACTURERS IN ITALY.

With regard to the way in which British manufacturers should deal with the Italian market I would urge them to give the selection of representatives most careful thought. In the first place they should send their own men with powers of attorney and not leave their interests in the hands of agents. Their representatives should have a thorough knowledge of the policy and organization of their firms; they should be men of international experience and, having knowledge of Italy and of Italians, able to understand the codified commercial law of the country and generally capable of inspiring confidence.

If a firm does not anticipate its turnover in Italy to be sufficiently large to warrant the opening of its own branch, it might get into touch with one or more other firms similarly situated and open a branch common to all in preference to resorting to agents. I know of a large German firm who considers that a foreign branch office pays its way when its establishment expenses can be covered by 8 per cent. of its turnover.

There is a tax on the capital of joint-stock companies working in Italy, and Italian law requires all concerns doing business in Italy to publish their balance sheets; it is therefore advisable to form separate subsidiary companies having their own share capital and their own boards of directors.

Italian bankruptcy law gives little protection to foreign creditors, and also for this reason the formation of Italian companies is recommended. All disputes are then settled in the Italian courts, and this greatly enhances the confidence of customers who do not know English law and who sometimes believe that the decision of a British judge often depends on the ability of one of the contending lawyers to rake up a law ignored by everybody, but enacted perhaps some 600 years ago.

Whenever possible Italian companies with their own works should be formed, or else some permanent understanding should be sought with an Italian works, as there are a great many cases in which it is distinctly helpful to say that the plant offered is made in the country, that spare parts can be obtained at any time with a minimum of delay, that experienced specialists are always available at short notice, and that repairs, if needed, can be promptly executed. Apart from this the Government gives a 5 per cent. preference to Italian-made material.

I would also advise British firms doing business in Italy to obtain from Italian makers as far as possible all the plant not of their own manufacture which they are supplying. There are excellent makers of prime movers in Italy; *Franco Tosi* has practically put a stop to the importation of steam engines and turbines, and *Riva & Co.* make first-class water turbines.

Italy has produced excellent electrical engineers, and has evolved solutions of her own for the special problems of generation, distribution and supply in Italy. If our manufacturers wish to be successful in Italy they must therefore adapt themselves to the needs and tastes of the country and not try to impose their views and their designs on Italian buyers.

ITALIAN STANDARDS.

The *Associazione Elettrotecnica Italiana*, which corresponds to our I.E.E., has drawn up a set of standards for electrical plant and apparatus which are very similar to ours; these standards will be translated into English by the International Electrotechnical Commission. The Association also intends to exhibit a set of samples of installation material of approved pattern, and it is proposed that it shall issue certificates to owners of installations carried out in accordance with its rules to facilitate insurance.

THE NEGLECT OF BUSINESS BY SCIENCE. By T. C. ELDER.

The boldness of the Editor in permitting Professor Sylvanus Thompson to publish in this journal his tribute of admiration to American and German employment of science in manufacturing can only be excused on a two-fold assumption: (1) the Editor did not agree with the Professor's contentions; (2) he did not expect the people who read the journal at home and abroad to agree either. It is certainly only in a British publication that such a critic would be allowed to lay about him without censorship. British self-depreciation is almost as notorious as German self-glorification. We can bear it and we can survive it. Why? Because the whole world has done business with us for very many years, and British quality has gained such a mighty goodwill up and down the earth that even we ourselves cannot damage it—by mere paper and paint.

It is almost equally bold to give me the task of "replying" to Professor Thompson. There are many friends of Britain thousands of miles away who will think it perhaps a little undignified to publish any reply. I feel so much like that myself that I prefer to say that I am following Professor Thompson.

His article is in three parts: (1) anecdotal reminiscence of a German technical ceremony; (2) a dissertation on British indifference to improvements in glass and dye manufacture; and (3) a general prophetic denunciation and awful warning. His opening narrative tempts me to be anecdotal too.

It was a house dinner at the Authors' Club, with Sir Oliver Lodge in the chair and Professor Sylvanus Thompson as the guest of honour, who had been announced to speak on the electrical industry. I had persuaded one of the brightest and brainiest of our power supply managers to accompany me as my consulting engineer and give us his views in the discussion. But when we arrived we discovered that the subject had been changed. For some reason or other, possibly because very pardonably he dreaded the difficulty of making electrical commerce go down pleasantly after a dinner of the scribes, the distinguished visitor preferred to speak on the neglect of literature by science or the neglect of science by literature—I forget which. Indeed I don't think I knew then, either before or after the speech, because I remember I was uncertain whether in my own contribution (crowded out for want of time) I could relevantly mention the double honours in science and literature of such men as Bacon and Huxley, or give a pat on the back of Charles Darwin for his appreciation of Gaboriau, or apologise for the oversight of Thackeray and Meredith in not making their heroes metallurgical chemists and mathematical dons. My companion, with a courage that roused my envy, brushed aside any alleged quarrel between the authors and the scientists and stoutly delivered an excellent little speech—on the troubles of the electrical industry.

This is recalled to my mind by Professor Thompson's article in *The B.E.A.M.A. Journal*, because again I have the impression that his emotions in contemplation of such subjects are stronger than his powers of reasonable exposition. These are good times for hearty and downright criticism, so far as the censorship gives leave, but you cannot avoid a little cynical amusement when you observe how every critic seems to have discovered just one wholly blameless and deserving class of the community—his own, when the truth is that we have all made our mistakes more or less, and from this point of view there was a good deal to be said in favour of the famous parting shot of Lord Haldane.

Professor Thompson bangs away with his John Knox punches at the Government, the manufacturer, the system of education, the trade unions, the universities. They have all done something wrong or left something undone. But I find nothing charged against the man of science. The suggestion is that he has been meekly and patiently waiting for employment, but that nobody would take notice of him. He has been ready to make us all rich, but we have gone blindly blundering on working for a bare living, and grumbling over needless grievances.

Now there are works in this country which are run by rule of thumb; there are manufacturers who have neglected opportunities for making something new and wonderful; there are some trade unions which have stubbornly fought against the introduction of new methods; there are universities which have seemed to scorn and despise science. But there is nothing in this country to justify or excuse Prof. Thompson in announcing to the people in so many parts of the world who see *The*

B.E.A.M.A. *Journal* "our backwardness and blindness," or in making the appallingly reckless general accusation of our factories "not being staffed with men of scientific training."

Does Prof. Thompson seriously mean that if you go through typical works of importance, if you inspect the making of ocean liners, armour plate, railway locomotives, motor-cars, electrical machinery, textile fabrics, right away down to jam and soap, you will notice the complete absence of anything worthy of the name of scientific process or anybody who has been trained in scientific method? I will not insist on selecting such examples as the business undertakings associated with such names as that of the late Lord Kelvin, or of Sir Charles Parsons or Sir Robert Hadfield, although I have the right to do this in view of Prof. Thompson's unqualified charge. I will not challenge him with Cunard liners and Rolls-Royce cars and ask him whether these and other British engineering masterpieces are thrown together by some sort of miraculously inspired ignorance. And he need not answer if I enquire why it is that when prosperous and powerful British companies erect replica branch factories abroad, they are more successful than are prosperous and powerful American and German companies when they build branch factories in England, or again why, O why?—these coruscating scientific manufacturing countries have had to entrench themselves behind tariff parapets to keep out the product of our "backward and blind" British works. It may be that his possible explanation can be suggested by the analogy of the boxing ring, where superior science is quite frequently humiliated by mere hard plugging. But if so, if Britain has done so much without science, I think science owes us some more profound interpretation of these facts.

Still, on the whole, I prefer only to charge Professor Thompson with the venial fault of rhetorical exaggeration. The truth is that there is a good deal of applied science in our factories, and at the same time there are other factories wherein short cuts to money-making are sought without much regard to the ever-dangling threat of technical obsolescence. Such examples exist in other countries; but they ought to be expected in Britain as the result of, on the one hand, the habit and momentum of past prosperity, and on the other hand, the *laissez-faire* attitude of the State and the public in refusing to grant security of tenure to fixed capital. These influences do not altogether prevent the erection of new factories and their successful conduct on scientific lines; but there are many cases in which the incentive to expend large capital on re-equipment or extension is necessarily not so strong as in protected countries.

But it is absurd to draw international comparisons without taking in all the circumstances. When people are arguing whether there is more science inside the factories of Britain or of Germany, I ask them not to forget what there is outside the factories. And I think it is much easier to prove that Germany applies scientific method more thoroughly and sedulously in her government, in her system of education, in her public commercial policy, than in her workshops; while here statesmanship is mere catch-penny vote mongering, education means to most people a wrangle between competitive priests for the right to peg out prejudices in the virgin soil of the infant brain, and as for public commercial policy there is none. The average factory manager shines brilliantly by comparison with the politician, the parson and the professor.

Are these things neglected by science, or is science neglected by them? It is really a two-edged question. Professor Thompson expects us to believe that scientifically trained men can save the nation, but that they will not or cannot do anything for us unless we offer them the job. I think it is fair to challenge them in the same way as other classes of the community who criticize the bad habits of the State; for example, the "business man," who pays his taxes and grumbles at the Government, but has not so far accepted as a business enterprise, properly to be undertaken with his brains and money, the task of providing us with a better Government. When have the men of science, who should be an aristocracy of intellect, ever attempted to exert a collective reforming force? The German professors as a body seem to have a certain amount of driving and directing power. Is it because the German people are more docile, or because their professors are stronger-minded than ours? They seem, certainly, to be more active and more nearly unanimous. They do not stay sulking within laboratories. They come out into the open, and they interfere in public affairs with, shall

we say, more or less intelligence. Now a business man travelling about the Fatherland might come back and report amongst his conclusions on German administration, that these people employ professors of greater horse-power, and more of them; but I do not think he would attribute that to the direct demand on the science market made by ordinary directors of manufacturing companies.

The really marvellous growth of German industry in a single generation is for the most part due to the fact that the commercial policy of that Empire has been directed, not by men who have got themselves elected by popular suffrage and manœuvred by intrigue to seats in the Cabinet, but by genuine expert leaders of banking, shipping and manufacturing; and most of these men to whom the Kaiser has given a free hand to organize German prosperity belong to a race much more ancient and much more intellectual than the Prussians. Given the liberty and the ability to make the most effective combinations with banks, factories, transport, diplomatic and consular services, politics—and science, they have discovered business-creating formulæ of wonderful potency, and it is upon economic foundations constructed by them that the Central Empires are able to base their astonishing defence against a siege by combined forces of the British Empire, France, Russia, Italy and Japan.

Now if British business organizers had been given the same task with the same privileges, and if they had enjoyed the same right to have the administration shaped to their approval, and if they had made the mistake of leaving out science, then if Professor Thompson had set out to smite them with lance and sword I should have been proud to slip in under his arm now and then with a dagger. But I hold that in both countries manufacturing policy must be considered in view of all the circumstances. It is not fair, and I doubt if it is scientific, to trounce them with general denunciations because they have not imitated the Germans in one particular when they have been restrained from having the benefit of German conditions as a whole. They have done their best in less favourable circumstances, and a very good best it has been.

Now to conclude, I think it is relevant to this discussion to cast a glance at the scientific influence of the learned institutions of which engineering has several very dignified examples. I have a warning from Professor Thompson's article to beware of rash over-statement; but I feel quite safe in going so far as to claim that electrical business men take far more interest in technical improvement than the Institution of Electrical Engineers takes in commercial progress. Has not the Institution refused over and over again to talk business? If Professor Thompson's article had been an exhortation to the learned institutions to come forward in view of the economic crisis, and to confer with manufacturers on the best method of co-operation in a great revival of industry, how much more timely and useful it would have been! The aloofness of the institutions, their claim to be scientific bodies having nothing to do with trade, their strange self-deception in the conventional hypothesis that they owe no debt to commerce—these are very tempting targets for Professor Thompson's machine gun. Possibly some candid member of the Mechanicals or the Electricals may say that it is only the science lords on their councils who are responsible for such errors, that, in fact, many of the ordinary members are in industrial employment, and that nearly all, whatever they are doing now, have at some time or other, been through the shops. But how curious that Professor Thompson, following an investigation by no doubt the highest scientific method, does not seem to have made such a simple discovery.

WHEN scientists, philosophers, artists, educationalists and industrialists (employers and employees) all recognize the respective functions of each, they will see the necessity for their intelligent co-operation in order to produce a better civilization, and they will apply their combined energies to the solution of the social problems about which men continually speculate and theorize.

THE BOARD OF TRADE AND BRITISH TRADE AFTER THE WAR. BY FRANK BROADBENT.

In July, 1915, the Advisory Committee to the Board of Trade on Commercial Intelligence appointed a Sub-Committee to prepare and submit a report showing what steps should be taken to secure the position after the war of firms who have undertaken industries in consequence of the exchange meetings leading up to the British Fair held under the auspices of the Board of Trade. As the enquiry proceeded, however, the scope widened, due very largely to the evidence submitted by the B.E.A.M.A., and as a result the report deals generally with the retention and expansion, after the war, of British manufacturing industries.

A detailed memorandum was prepared by the B.E.A.M.A. giving a considerable amount of data in reference to the handicaps under which British Electrical and Allied Manufacturing Industries have suffered in the past, and making specific and definite recommendations with a view to their removal.

A deputation from the Association subsequently attended and gave evidence before the Committee in support of the recommendations made, and it is very gratifying to find that its recommendations were very generally adopted by the Sub-Committee, many of them being reproduced *verbatim* in the body of the report and summarized in the specific recommendations made by the Sub-Committee.

PATENTS, TRADE MARKS, ETC.

On this subject the Sub-Committee officially put forward the B.E.A.M.A. recommendation that "continued effort should be made to secure uniformity of Patent Law throughout the British Empire." In a special report on Patent Law which has since been submitted by the B.E.A.M.A. it is recommended that the term of the ordinary patent be extended to fifteen years; that patent fees be reduced; that search for novelty be either abolished altogether or its scope widened to make it effective; that the provisional period be extended from six to twelve months; that the time for acceptance of a patent after filing be extended; and that a short term or petty patent be established for improvements in mechanical devices which are not capable of being covered by registration of design.

It was also suggested by the B.E.A.M.A. witnesses that the India Empire be urged to pass a Trade Marks Law, this suggestion being embodied also in our special report, and it is satisfactory to find that the Sub-Committee officially put forward this recommendation.

TRANSPORT FACILITIES.

The B.E.A.M.A. gave considerable data in regard to railway, canal and overseas traffic, showing the handicaps under which British Industry suffers in relation to foreign competition. Data was given showing the lower rates charged on German than on British railways, more particularly in regard to export trade, and also as to the preferential rates given by British shipping companies to foreign goods carried in the same boats as British goods. These questions have formed the subject matter of enquiries by Royal Commissions, but hitherto no specific recommendation has been made with a view to remedying the evil. The B.E.A.M.A. made the definite recommendation that

> "the Board of Trade should, as soon as possible, call together a conference of representatives of shipowners, railway companies, and manufacturing industries, to discuss the whole question with a view to co-operation in removing the existing handicaps under which British industries labour when in competition with foreign producers." They further recommended that "an impartial tribunal of the Government be set up to exercise the functions of a tribunal for adjusting grievances existing between railway and transport companies and producers, more particularly where it can be shown that the foreigner is benefiting at the expense of British Industry."

The Sub-Committee adopted the latter recommendation and it will perhaps rest with the B.E.A.M.A. itself to initiate means for bringing about the co-operation outlined in the former recommendation. The Sub-Committee made other recommendations based upon the evidence and data given by the B.E.A.M.A., notably

> "that a definite policy for the improvement and extension of the canal system of the United Kingdom should be formulated with a view to its being carried out as soon as national finance so permitted"; and again, "that shipping companies should be prohibited from charging higher rates of freights

DISTRIBUTION OF BRITISH ELECTRICAL AND STEAM

"The Beama Journal" Supplement, No. 2, April, 1916.

MANUFACTURES THROUGHOUT THE WORLD

Stanford's Geographical Estab^t. London.

from shipping ports than from any north European ports."

On the subject of Government financial assistance the Sub-Committee were particularly interested in the methods adopted by the German Government to assist industry, and on this question the B.E.A.M.A. witnesses were able to give them a considerable amount of first-hand information. The assistance rendered to industry by the system of Kartels and syndicates was described in considerable detail in earlier numbers of *The Beama Journal*, but it is perhaps not generally known that the German Government as owners of coal mines, ironworks, chemical works, etc., are members of powerful Kartels and through them are in a position to render financial assistance to export industries without appearing to pay direct export bounties.

Emphasis was laid by the B.E.A.M.A. representatives on the unpatriotic action of British Government Departments, municipalities and other public bodies in placing contracts of considerable magnitude in Germany, and it was pointed out that the placing of such contracts by powerful municipalities had a marked influence on smaller public bodies and also on municipal authorities in our Colonies and overseas Dominions. Whilst the value of the contracts did not form a large percentage of the total value of engineering contracts, yet it had a marked influence in keeping down British prices to an unprofitable level. It is therefore satisfactory to find that the specific recommendation made by the B.E.A.M.A. was officially put forward by the Board of Trade Advisory Sub-Committee, namely, that "all Government Departments, Local Authorities and Statutory Bodies entrusted with the control of monies raised on the security of rates or taxation, should be under legal obligation to purchase, so far as possible, only goods produced within the British Empire."

To carry out these recommendations it was definitely recommended that a Government Department be established which should be quite independent of the Board of Trade and should be charged solely with the duty of safeguarding British industry and trade. This recommendation was officially put forward by the Sub-Committee.

Whilst all the foregoing recommendations are important, it was considered by the Council of the B.E.A.M.A., in view of the unprecedented conditions created by the war, that special emphasis should be laid upon the question of tariffs. During the war practically the whole of the works of our members have been under Governemnt control mainly occupied in the manufacture of munitions, their normal productions being in the meantime suspended and falling largely into the hands of neutral manufacturers. In many cases large extensions to premises and plant have had to be made to cope with the abnormal conditions. On the cessation of hostilities, the manufacture of munitions in these works will cease, so it is essential that some provision be made to ensure that the factories shall be kept employed, as otherwise large numbers of the skilled and unskilled workers at present engaged on this work, in addition to those whom we all hope will return from the front, will be thrown out of employment. After careful consideration of the whole matter the following resolution was unanimously adopted by the Council and submitted to the Sub-Committee who printed it *in extenso* in their report:—

"That the Government should, as soon as possible, proceed to formulate a tariff scheme, embodying:—

"(1) An Imperial Customs Union between Great Britain and her overseas Colonies, Dominions and Dependencies, with a view to the adoption at some later period of free trade within the British Empire.

"(2) A tariff on all goods imported into this country which are such as can be efficiently and economically manufactured in British workshops.

"(3) That a substantial preference should be given to all goods, whether manufactured or otherwise, imported from any portion of our overseas Empire.

"(4) That a smaller preference than the foregoing be given to those countries which are now allied with us in defending the right of national existence against the dominating influence of the Central European Powers.

"(5) That such preference as may be possible, having in view the balance of trade between nations, be given to neutral countries.

"(6) That the duty imposed on goods of Austrian and German manufacture

should be of a highly protective character, not only in Great Britain, but also in the overseas parts of the Empire."

It will be seen from the foregoing *résumé* of the enquiry that, as was pointed out by the President of the Board of Trade in the House of Commons on January 19, "many of the recommendations are of wider scope than the particular group of industries to which the enquiry of the Sub-Committee was confined."

This ought to facilitate carrying out the recommendations if it should be found that they involve general and fundamental issues which apply to all industries, and if the majority of members of the different industries are agreed that their adoption would be beneficial to them and to the nation. Different industries are so inter-related that recommendations made by one branch of industry might be detrimental to others. Claims for consideration by any special class have to be viewed in relation to the whole, and the *national* interest should be the basis of any legislation or innovation.

PUBLICITY CAMPAIGN: B.E.A.M.A. BRITISH TRADE COMMITTEE.

Under the direction of *The B.E.A.M.A. British Trade Committee*, a campaign is being carried on for bringing home to the minds of the public, and especially, in the first instance, to the engineering public, (1) that the defences of this country and of its Allies have been based on the engineering resources of Great Britain, and (2) that the proper utilization of these resources after the war is the shortest road to the restoration of prosperity. Mr. T. C. Elder has been attached to the Committee as special publicity representative, and pictorial leaflets and post-cards have been prepared for distribution, each of which makes a point in favour of continued support for the engineering industry after the war. A six months' lecture tour in important centres is in progress with a view to stimulating a more patriotic spirit amongst buyers of machinery, and to encourage the closer organization of the engineering industry.

The first meeting was held in Birmingham, on February 23rd, when the very valuable help of Mr. Dudley Docker as Chairman was obtained. The meeting was thoroughly representative, and the speeches made by Mr. Docker, by Sir Halliwell Rogers, and Messrs. Edward Manville, Harris Spencer and Gilbert Vyle were straight to the point and very useful indeed in emphasizing special points.

The lecture and discussion are being reprinted in pamphlet form and can be obtained from the Secretary of the B.E.A.M.A. The special question dealt with by Mr. Elder on this occasion was the financial aspect of the problem as indicated in the following passages:

> The profitable employment after the war of the greatly enhanced output capacity in the engineering industry is not a manufacturing problem, but a financial problem. It is a common opinion that there must come a tremendous prospective demand for metal and machinery manufactures for three main purposes, (1) The destruction caused by war to cities, railways, bridges, roads, harbours and so forth will presumably need to be repaired; (2) necessary public works and important private enterprises in both belligerent and neutral countries are kept in suspense because the factories of Europe are making guns and shells instead of agricultural or industrial machinery; and (3) the attainment of a settled peace will greatly encourage new schemes for economic development in every part of the globe.
>
> These reasons are not in themselves all sufficient. Those who rely on them do not clearly understand the difference between natural demand and effective demand. There are always in this country, for example, in the most prosperous times at least ten million persons who ought to have a new pair of boots. No boot manufacturer argues from that the imminence of a boom in his business. He knows that unfortunately they have not the price in their pockets. Theirs is not an effective commercial demand. Similarly there are no doubt many thousands of people who would gladly own a motor car; but the market for the motor manufacturer only consists of those people who can afford to buy. The natural human demand for commodities and services is boundless. Practical and prudent commerce is only concerned with people who possess cash or credit: who are able as well as willing to buy.
>
> On the one hand, then, while it is quite true that in all the areas ravaged by war, from Northern France and Belgium to Poland and Galicia, and from the Adriatic to the Tigris, there will be widespread need of reconstruction; that in Canada and Australia and South America and Russia there will be an almost insatiable hunger for industrial machinery; and that in this country plans for public works have been laid aside representing many large contracts to come; and, while, on the other hand, it is equally true that the output capacity and productive efficiency of machinery manufacturers have been amazingly increased, not only in Britain, but in Germany and America, in France and Russia and Japan, that does not by any means prove that there must necessarily be a wonderful revival of prosperous business. The shop may be fully stocked and staffed; a crowd of customers may be impatiently

rapping on the counter; but unless they can rap with gold coin they must wait till terms of payment can be arranged. The only thing that will count is--command of ready money, or of what is quite manifestly ready money's worth. Finance alone can open the market gates and bring together the manufacturer and the user of machinery. A very large proportion of the output of engineering works is purchased with newly raised capital. If the customer cannot raise that capital on his own credit, either the manufacturer or some third party must shoulder the financial burden — or else no business will be done.

Now we have no precedent to encourage us to believe that this obstacle can be easily surmounted. The most reasonable inference is that there will be a financial crisis continuing after the war during which the potential supply of engineering and hardware manufactures will greatly exceed the effective demand. A century ago it was only the textile mills of England that were in this unhappy position. This time it will be an international congestion. Not one alone, but three great manufacturing export countries, Britain, Germany and America, will be concerned. They will all be in possibly desperate need of customers for their machinery. Certainly the world will want it. The world wants many more thousands of miles of railways; many more thousands of steamships. Almost countless are the towns in foreign lands which are in need of modern engineering improvements in their public services. The average citizen of the world, even in what are deemed to be the most civilized parts, is still unprovided with domestic apparatus that is already invented and on the market. Innumerable factories and workshops are still equipped with old-fashioned machinery. Enormous areas of agricultural territory are still farmed unscientifically. Within recent memory the engineering industry has presented to the world turbine steamers, electric trains, public and private motor cars, aeroplanes, a great number of automatic tools, and a wonderful list of miscellaneous advances in mechanical civilization. The only thing that checks the pace of their universal adoption is the limitation of purchasing power.

Does anybody claim that the purchasing power is growing during the war? That purchasing power will be less just when the productive power in the engineering factories will be greater. There will not be enough orders for all the factories—unless some new financial system is devised for bridging over the gap between demand and supply. There may be only enough business in the world for half or two-thirds of the aggregate output capacity of Britain, America, and Germany. . . . .

But surely, someone may say, if finance is going to be so decisive, will not Germany be in a much worse financial condition than this country? Will not Germany's economic condition be crippled for many years? On the contrary, still assuming that we neglect to make timely and sweeping reforms in our trade policy and that we resume peace with conditions as in 1913, Germany will have some great competitive advantages. Financiers are a sort of separate nation apart, with the City of London for its metropolis, but possessing no territory and no sentiment; and if you want that nation for an ally you must do certain things to attract it. Both the professional financier and the private investor seek to place their money where it is secure and remunerative.

The second meeting was held in Manchester on March 21st, with the Rt. Hon. the Lord Mayor of Manchester in the Chair, and a large representative audience. The thanks of the B.E.A.M.A. are due to the committee of *The Engineers' Club*, of Manchester, for its able assistance in making the arrangements for this meeting. Some paragraphs from Mr. Elder's lecture are given below:—

The people are in the mood for mutual toleration in regard to old political controversies, and if we can see any opportunity of reconciling factious differences in the hope of constructing a truly national policy that will endure when the present crisis is past, it is our duty to discuss fiscal and other questions in this spirit. When I speak, therefore, of a coming commercial reformation, it is fitting that I should remind you that there was a commercial revolution a century ago, but it was painfully prolonged because those who were in a position of authority chose to be wedded to certain principles, and were even more henpecked by those principles than the politicians and economists of to-day. The saving grace of the British people is their ready devotion to expediency and opportunism. They will not be hurried, but when there is obviously something to be gained they will take practical steps with a cheerful disregard of logic or consistency. The repeal of the Corn Laws was not a question of principle, but of expediency. It was not the realization of the teachings of Adam Smith; it was a practical measure engineered by Manchester manufacturers who were confronted with obstacles to the expansion of their business. Their industry, in fact, required and deserved and obtained protection—protection in a peculiar form, if you like, but it was the only method available. Their industries which had been previously established in England by ordinary protective measures needed after the Napoleonic wars special legislation dictated by the extraordinary situation of the country as being now without competitors in manufacturing, and only asking that foreigners should be given better facilities for buying our goods by shipping their natural products to our free ports. The repeal of the Corn Laws was intended to confer, and did in effect confer, a bounty on British manufacturing.

The time has come when we ought to drop for ever this false and fraudulent antithesis between Free Trade and Protection. The two exist in a mixed form here and in every other country. There is no question of principle involved whatever, except one that is common to both. So long as the world is divided by racial and national boundaries, so long must continuous study be given, from the point of view of expedience, to the best means of securing for the people within those boundaries steady and remunerative employment, not leaving out of the question, of course, the nature of the employment in its relation to physical and mental development.

It was the Manchester business men, engaged mainly in the textile trades, who had to take in hand the commercial reformation after the Napoleonic wars,

and who founded quite innocently, I am sure, the Manchester School of Economics. They did not set out to find schools, but to find markets for their goods. To-day it is the business men engaged mainly in the engineering trades who must have the courage and energy to lead the way, and they may very well be men of Manchester, because engineering is now Manchester's greatest industry.

British engineering men must be thinking and planning now. They are entitled to the support of the Government. They have the strongest claim on the sympathy and encouragement of the people. But they must rely wholly on neither. They cannot count on the unfailing wisdom of Government measures or on the steadfast and thoughtful patriotism of the buyer. They must be powerfully organized. They must, in the words of the "Marseillaise," "form their battalions." Every week they delay now they are adding to their future difficulties and courting disaster.

They have to find markets for an enormously increased output capacity; and they can only do it by collective action.

A valuable discussion followed; amongst those who contributed were Messrs. S. Z. de Ferranti, W. Stokes, Chairman of the B.E.A., C. H. Woodingham, Vice-president of the I.E.E., and Ald. W. Walker, Chairman of the Council for the Organization of British Industry. The next lecture will be given in Newcastle-on-Tyne and the one following in Glasgow.

EFFICIENCY IN THE ELECTRICAL BUSINESS.

The following character study in the French-Canadian dialect appears in the January *Jovian* and is written by Mr. George C. Rough biographer of Jean Baptist Trudeau who is assumed to be speaking :—

'Bout dat 'fishcient bizness.

I mak' de beeg study on dat two-tree year 'go when am start for be de electricien.

Dat tam am get de beeg contrac' for put heem four bell on de house of de Curé, an' am go on Montreal queek for buy material—batteree, two poun' wire, salt, tack an' few 'noder ting.

Am buy heem 'holesale and get reduction two per cen' for catch.

Save 'bout dix cen' on dat.

De secon' class return ticquette cos' une dollaire, but am mak' purty good profit on de job anyhow, beside de good tam also.

Mos' two dollaire balance affer all expense she's pay.

Get plenty 'noder job too affer dat, 'cause de Curé hees geev me de bon recommender.

Den am tak' de contrac' for wirin' de house pour la lumière electrique (de conceal' job). Of course bor' hol' on de jois' is ver' slow, an' hard on de neck. Also when you clim' up an' down de laddaire every two hol', it tak' de long tam and cos' money.

So am look aroun' for see if dere's not some 'fischient bizness dat mak' it more queek.

Firs', am tink mak' it de platform on de wooden hors', but am fin' affer you bor' 'bout ten hol', you got move de hors', an', of course, dat tak time, 'especially de boy am hav' for hel-pin' me is wat you say, "Not wort hees salt."

Never min'! Am get two-tree purty good contrac' an' mak' de leetle money, an' all de tam study some way for bor' dose hol' more queek.

At las' am see one day, when am in de office of de Compagnie de Electricitie et Gaz et Pouvoir, picture of de machine dat mak' de hol' any place from where you stan'—up on de jois', 'roun de corner, underneet de floor—any place where you want to pass de wire. Don' mak' no difference jus' so long you turn de crank.

So am write de feller an' tell heem sen' me one of dem, tout suite, for try on de nex' contrac'.

He sen' dem C. O. D. (Yankee Patent).

No matter for dat, am tak' heem out on de job an' my hel-per is feex heem up and put on de ⅞-bit.

I commence for turn de handle lak Italian organ man, an' de hol' is come ver' fas', an' am tink sure enough plenty 'fishcient bizness : when, sacre tonnerre, don' get half troo de job, de bit she's come loose an cut my arm so am stay in bed tree day, an' all dat 'fishcient bizness gonta-ell.

All de tam in bed am tink—"Wat's de use try 'fishcient bizness all by yourself ?"

Unless de 'noder feller do de sam' ting you go'in get lef' for sure.

If de boy he feex dat bit correc' way firs' place, de hol' bizness she not bus' up an' am not lose money on dat contrac.'

Tout à fait.

Coopérer.

Wat you call "co-operation."

Dat's de ting.

Everybody do someting dat's good for heem, an' not do noting dat's bad for de 'noder feller.

Dat's ting for mak' 'fishcient bizness.

Moral, supplied by the reporter :—*No man is sufficient unto himself.*

ROTARY CONVERTERS. By F. P. WHITAKER.

It is now approximately a quarter of a century since the first rotary converters were developed by connecting slip rings to the armatures of D.C. generators. Some of these early machines gave an excellent account of themselves, while the record of others, especially the higher frequency ones, was not so satisfactory.

Since that date the development of the rotary converter has been one of continuous progress, perhaps with a few disappointments; but these only stimulated further research, and so finally helped to a thorough understanding of the factors which enter into rotary converter design.

The result has been that starting currents have been reduced to at least one-fourth of early values, outputs from a given diameter of armature have been quadrupled, efficiencies have been increased, parallel running has been perfected, and mysterious troubles have become well-known phenomena. Several types of converters have been developed to suit various applications, reliability has been greatly improved, initial cost of equipment has been greatly reduced, and the rotary converter is now being installed wherever efficient and reliable apparatus is required to convert from alternating current to direct current, or *vice versa*.

These notes have been written to review briefly the developments that have taken place, and to illustrate the influence of the latter on the operating characteristics of the modern converter.

STARTING.

The earliest machines were started by connecting the slip-rings of the converter to 1/2 or 1/3 voltage tappings in the transformer. The rotary would run up to, and into, synchronism, after which the field circuit could be closed, and the machine thrown over quickly to the full voltage tappings. This method of starting was generally adopted in America, particularly for 25-cycle railway service; but has been little used in England, except for small sizes, on account of the large starting current generally (though not necessarily) required, and the undesirable manipulation of heavy switches. Also, while on large machines without commutating poles the sparking at the commutator during starting was permissible, this was no longer the case on commutating pole designs. Direct current brush-raising devices have been used to overcome this difficulty, but they cannot be considered desirable additions to rotary converter commutators.

This method no doubt had the advantage of being quick starting and self-synchronizing, and is still a satisfactory and economical method for small sizes of commutating pole machines, say up to 200 kw.

The induction motor method of starting was introduced to obtain low starting currents. While objections have been raised against this method, as it necessitates synchronizing the rotary, yet it is the method that was generally adopted in England for some time, and gave excellent results.

Recently a method of starting has been perfected combining the advantages of both the previous methods, in which the induction motor stator windings are connected in series with the rotary armature at starting. The induction motor starts the rotary and brings it up to synchronous speed, at which point the motor acts as a synchronizing reactance and allows the rotary to synchronize automatically with the supply through the stator windings of the motor. So soon as the rotary has synchronized, the induction motor stator windings can be short-circuited, and the rotary is ready for paralleling on the D.C. bars.

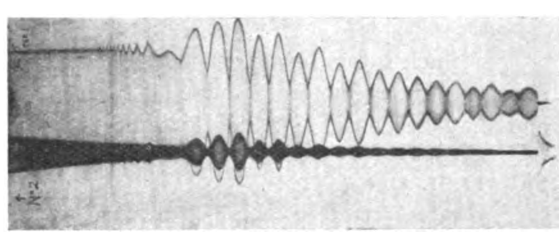


Fig. 1. OSCILLOGRAM TAKEN ON A 1,000 KW. ROTARY CONVERTER DURING STARTING AND SELF-SYNCHRONISING.

The development of this method of starting entailed some minor difficulties—especially when starting rotaries with a small number of poles—but these have been overcome, with the result that now any size of machine can be started without sparking at the commutator or reversal of polarity, and be ready for paralleling on the D.C. busbars inside one minute, without taking more than 35% of full-load current from the H.T. mains.

Figure 1 shows an oscillogram, taken during starting, on a 1,000 k.w. rotary, and records the A.C. current taken from the line (No. 2) and the voltage across the induction motor stator windings (No. 1). The time taken to self-synchronize and to short-circuit the induction motor windings was 45 seconds. The point will be seen at the end of the film at which the stator was short-circuited. The starting switch was closed just as the film commenced to revolve.

As the rotors of starting motors have at times to stand severe and trying conditions, the design of the rotor has been continually simplified and perfected, until to-day the simplest and earliest form of rotor is in use, which consists of a cylinder of cast metal.

Such rotors have been developed for all sizes of starting motors and for all frequencies, and may be considered literally indestructible.

PARALLEL OPERATION.

One of the earliest difficulties encountered was that of hunting. Some of the earlier machines fitted with laminated poles and primitive bridges were soon found to be less stable than solid pole machines, although the former were generally of higher efficiency. This resulted in many of the early machines being built with solid poles, but at the same time led to a gradual improvement in the form of bridge fitted to machines with laminated poles, until finally such construction became standardized, and the solid pole was discarded.

With the introduction of commutating poles, much larger outputs were obtained from a given size of machine, and again it was found necessary to improve the damping arrangements of such converters.

There is no doubt that the improvement in the construction of damping bridges, made just after the introduction of commutating poles, has been one of the greatest factors in the development of the modern converter, especially where the higher frequencies are concerned.

The damping of modern machines has been increased until to-day hunting is practically unknown.

FLASH-OVER.

Many of the early 50-cycle machines, due to insufficient damping, and limitations which existed in designs not having commutating poles, were prone to flash-over. The introduction of commutating poles has enabled the designers so to alter the proportions of these machines that to-day flash-overs only occur when very heavy loads are suddenly thrown on or off a converter.

Figs. 2 and 3 show oscillograms taken on two 400 k.w., 800 r.p.m., 750 volt, 40-cycle commutating pole rotaries connected in series to give 1,500 volts from positive to earth.

These machines were short-circuited seven times through a length of feeder so arranged that five times full load was thrown on the machines with a knife switch, and automatically disconnected with a circuit breaker. Three times the rotaries withstood the load being thrown on and off without flashing.

Fig. 2 shows the performance of the rotaries when no flash occurred, while Fig. 3 gives a record of the connection when the rotaries flashed-over.

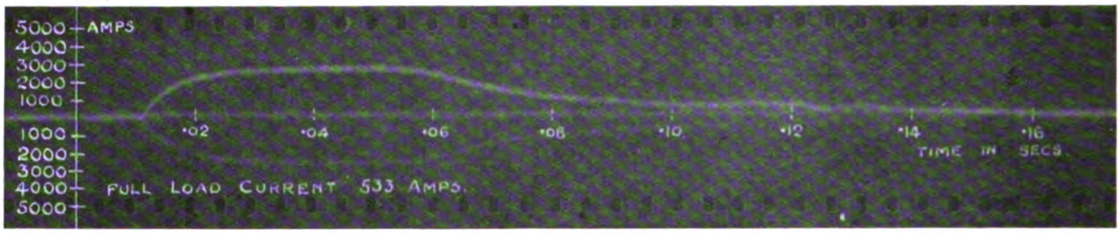


Fig. 2.

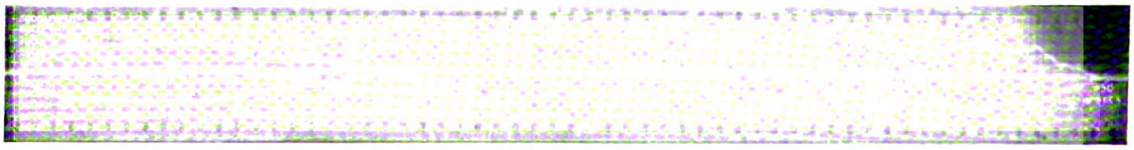


Fig. 3.

OSCILLOGRAMS TAKEN ON TWO 400 KW. ROTARY CONVERTERS DURING SHORT-CIRCUIT.

It will be noticed in Fig. 3 that the machine withstood the heavy load and did not flash-over until the breaker had completely opened.

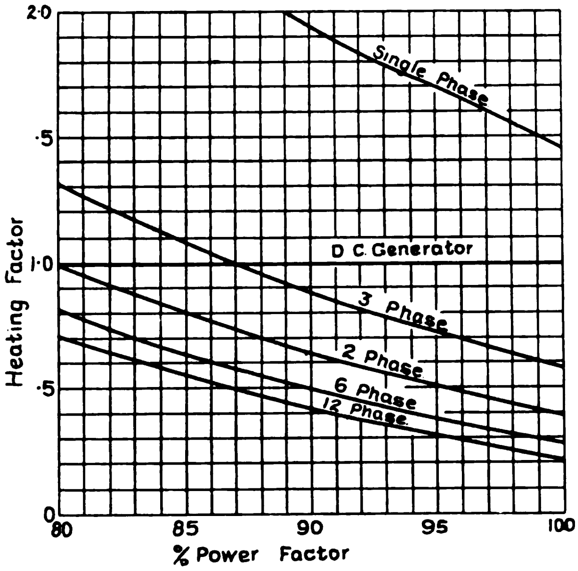


Fig. 4. ROTARY CONVERTER ARMATURE HEATING.

HEATING FACTOR $= \frac{C^2R \text{ Loss as Rotary Converter.}}{C^2R \text{ Loss as D.C. Generator.}}$

These curves were taken by Mr. E. Fawssett for Messrs. Merz & McLellan, and illustrate clearly the growth and decrease of current in an inductive circuit, and also the instability of the electric arc.

The curves were taken with two strips, the lower curve being a duplicate of the top one.

The tendency of a machine to flash is directly associated with the maximum volts per bar, and, with normal designs, to the average volts per bar. There is a maximum limit to this figure, and while this is difficult to define for various designs and duties which machines have to fulfil, it can be taken that for conservative working the average voltage per bar should not exceed 13·5; a little higher value being permissible on lower frequency sets than on those built for the higher frequencies.

Although flash-overs may not be frequent even in railway work, and rarely occur in power and lighting stations, a good deal of attention has been directed to providing clear open commutators and to perfecting the protection of details of the brushgear, so that in the event of a flash-over, little, if any, damage is done. The view in Fig. 9 will illustrate this point.

ARMATURE HEATING.

This is a minimum at unity power factor, and increases with decrease in power factor, either leading or lagging.

Fig. 4 shows the heating factor for various types of machines, *i.e.*, the ratio of armature loss as a rotary to the armature loss that would exist as a D.C. generator for the same D.C. output.

NUMBER OF PHASES.

While nearly all the early machines were built 3-phase, practically all machines are now built 6-phase, even for capacities as low as 100 k.w., on account of the increased efficiency and lower heating obtained. This leads to the consideration as to whether or not the 12-phase machine will be a likely construction in the future. It would appear that decrease in heating and increase in efficiency are hardly likely to justify the increased expense of fitting twelve sliprings, especially as there are serious limitations placed on the transformer design with the ordinary 12-phase connection from a 3-phase supply.

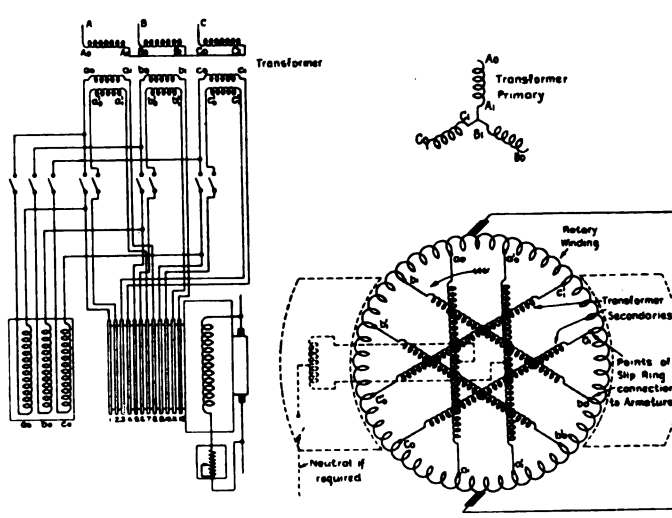


Fig. 5. SPECIAL CONNECTIONS OF A 12-PHASE ROTARY TO 3-PHASE SUPPLY, WITH SELF-SYNCHRONIZING INDUCTION MOTOR.

A modification of the 12-phase connection has recently been suggested which removes the limitations of the transformer design, and has many other desirable features, so that it is quite possible that this winding will be used in the future for large capacity sets.

Fig. 5 illustrates the connections for this case; the heating effect is almost identical with that obtained with the ordinary 12-phase connection.

COMMUTATION.

Most of the early 25-cycle machines presented rather fewer difficulties than are usually associated with the design of D.C. generators; but this was not so with the 50 and 60-cycle converters. Outputs gradually increased on 25-cycle rotaries for a given frame, until makers had standardized those machines which represented the maximum output that could be obtained from a given size of frame with conservative commutation limits and without commutating poles.

With the introduction of commutating poles, larger outputs were obtained from 25-cycle machines, while the construction of higher frequency machines was given an enormous impetus. It was not, however, until the instability of multipolar armatures, the effect of reactance and the influence of wave form had been thoroughly investigated, that the disappointing results obtained with a few of the early commutating pole designs could be accounted for, and the full benefit from commutating poles could be reaped.

The marking or blackening of commutator segments formed one of the earliest troubles connected with commutating machinery, and some of the causes were accentuated as larger outputs and higher speeds were obtained from a given size, and as commutating poles were introduced. The phenomenon of blackening in every few segments or slots, or in regular or irregular patches, has been gradually solved, and when this history comes to be written in full, it will form some of the most interesting pages in the development of converting machinery.

THREE-WIRE SERVICE.

If the midwire of a three-wire system be connected to the neutral point of the secondary of the transformer, a rotary converter will operate with a large out-of-balance current with excellent regulation. With 25% of full load current in the neutral the difference in voltage between the two sides of the system need not exceed ½% of the voltage across the positive and negative mains.

VOLTAGE VARIATION.

With the ordinary rotary converter, a fixed ratio exists between the A.C. and D.C. voltages.

In the following table the theoretical no-load (unity power factor) ratios have been given, which are based on a sine wave distribution of flux in the air gap. In practice these ratios differ from the theoretical ratios by values up to approximately 5%, dependent on the distribution of flux in the air gap, the load on the rotary and the power factor of the load.

The values given should not be used for ordering transformers for rotary equipments, but may prove useful for preliminary work, and will be quite satisfactory for settling the size of switches, capacity of cables, etc., required in connection with rotary installations.

Assume D.C. Voltage = 1 D.C. Current = 1

	Single-Phase	2-Phase	3 phase Delta	6-phase Diametrical
Voltage of Transformer	0·707	0·707	0·612	0·707
Voltage between adjacent rings ..	0·707	0·500	0·612	0·354
Current per line A.C. L.T. side. (Efficiency 100%)	1·414	0·707	0·943	0·472

From the ratios given above, it is evident that the D.C. voltage of a rotary is approximately fixed by the A.C. voltage applied to the slip-rings; but several methods have been developed for varying the D.C. voltage, amongst which are the following:—

Reactance Control.
Booster Control.
Induction Regulator Control.
Split Pole Control.

Reactance Control. As explained above with constant A.C. voltage applied to the slip-rings, the D.C. voltage will be practically constant on the ordinary type of converter. In the case of reactance control, in order to vary the D.C. voltage, the slip-ring voltage is varied, even though the applied voltage at the high-tension terminals of the transformer remains constant. This control is effected by the

introduction of reactance in the transformer supplying the rotary converter, or by means of a separate external reactance. The percentage reactance installed will depend on the conditions under which the converter has to operate, and can be fixed to suit the case under consideration.

The method by which the voltage at the slip-rings is varied is illustrated in the following diagrams, which have been drawn for a transformer ratio 1 to 1 :—

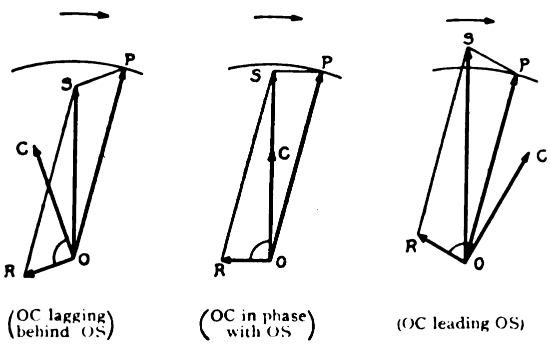


Fig. 6. VECTOR DIAGRAMS, REPRESENTING REACTANCE CONTROL.

O P is a vector representing the voltage at the H.T. terminals of the transformer, and is assumed constant.

O R is a vector representing the reactance voltage produced by the current O C passing through the reactance.

O S is a vector representing the slip-ring voltage, which is the resultant of O R and O P.

It will be seen from the diagram that if the field of the rotary is adjusted to draw a lagging current, the effect of the reactance is to lower the slip-ring voltage, and if the field of the rotary is adjusted to draw a leading current the effect of the reactance is to raise the slip-ring voltage.

With this control the power factor on the high tension side of the transformer varies with the direct current voltage, and the variation will depend on the range in voltage required.

Booster Control. This method of varying the D.C. voltage is obtained by inserting an A.C. booster between the slip-rings and armature of the converter.

The A.C booster increases or decreases the A.C. voltage applied to the rotary armature and so raises or lowers the D.C. voltage.

With booster control the power factor is independent of the load and voltage, and consequently unity power factor can be obtained, or, if necessary, leading current can be drawn under any condition of load and voltage.

Induction Regulator Control. In this case the D.C. voltage is varied by inserting an induction regulator between the transformer and the rotary slip-rings.

The induction regulator increases or decreases the A.C. voltage applied to the rotary armature, and so raises or lowers the D.C. voltage.

Similarly to booster control, the power factor is independent of load and voltage.

Split Pole Control. With this method of control the main poles of the rotary are divided into two portions, the regulating pole and the main pole proper.

The main poles are excited similarly to those of ordinary converters, whereas the regulating poles are arranged so that they can be excited either in the same direction as the main pole or in the opposite direction.

The D.C. voltage between the positive and negative brushes is proportional to the algebraic sum of the flux produced by the regulating pole and that of the main pole.

The A.C. voltage between slip-rings is not proportional to the algebraic sum of the fluxes, because they are displaced nearly 90 electrical degrees ; but it is equal to the vector sum of the A.C. EMF's produced by the two fluxes.

The design is such that the algebraic sum of the fluxes can be varied over a considerable range without greatly varying the vector sum of the A.C. EMF's generated by the two fluxes.

The maximum D C. EMF is generated when the regulating pole is excited in the same direction as the adjacent main pole, and the lowest D.C. EMF is obtained when the regulating pole is excited in the reverse direction to that of the adjacent main pole.

It will be seen that although the A.C. voltage remains practically constant, the D.C. voltage can be varied over a wide range.

With this method of varying the D.C. voltage, unity power factor can be obtained under any condition of load and voltage ; also, the control is effected in the armature of the rotary without the addition of booster or regulator.

The wave shape of split pole equipments can be guaranteed to conform practically to a sine wave, and will not introduce disturbing factors into any system.

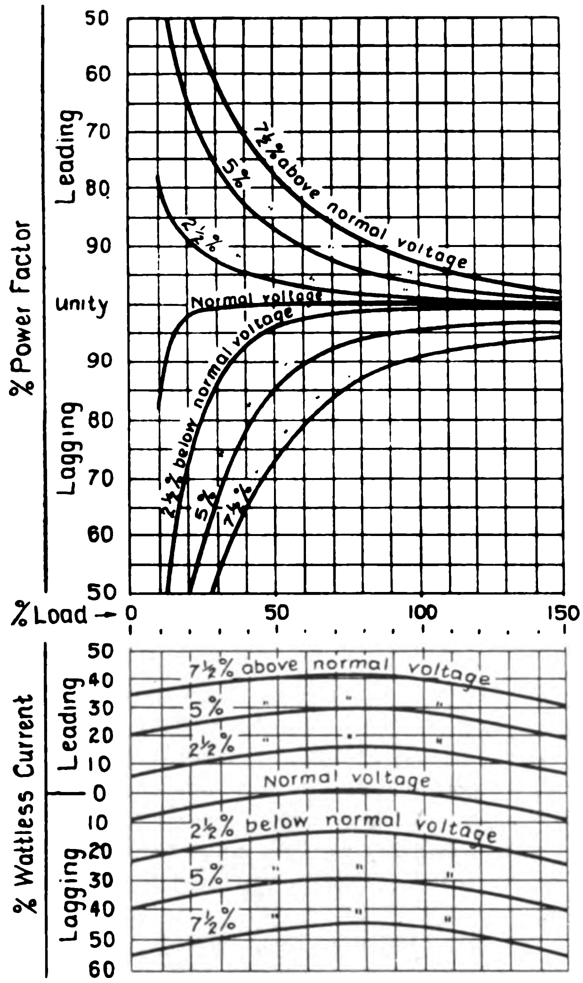


Fig. 7. ROTARY CONVERTER WITH REACTANCE CONTROL POWER FACTOR ON LINE.

APPLICATION OF THE VARIOUS METHODS OF CONTROL

Reactance Control. The reactance method of control is the cheapest and simplest, and is generally installed for conditions of service that do not require more than 10% to 15% voltage variation, and where it is not necessary to control the power factor independently. It is not advisable to call for larger voltage ranges than will actually be required, as the cost of such equipments may be increased thereby.

It is often stated that the voltage control by this method is poor, on account of the low power factor at which such equipments operate. This is not the case providing the variation in D.C. voltage does not exceed 15%; and such a range covers most conditions in practice.

With constant voltage from no-load to full load the power factor will be approximately unity. With 5% variation in either the D.C. or the A.C. side, or 2½% in the A.C. and 2½% in the D.C., the wattless current drawn from the line under the worst condition of load and voltage need not exceed that which corresponds to 97% power factor on full load. With 10% variation in the D.C. or A.C. voltage, or with 5% variation in each, the wattless current under the worst condition of load and voltage need not exceed that which corresponds to 95% power factor on full load. With 15% variation in D.C. or A.C. voltage or 7½% in each, the wattless current drawn from the line under the worst condition of load and voltage need not exceed that which corresponds to 90% power factor on full load.

When it is necessary to install converters for operating on both lighting and traction busbars, reactance controlled machines are admirably suited. The transformer can then be provided with a lighting tap, which will

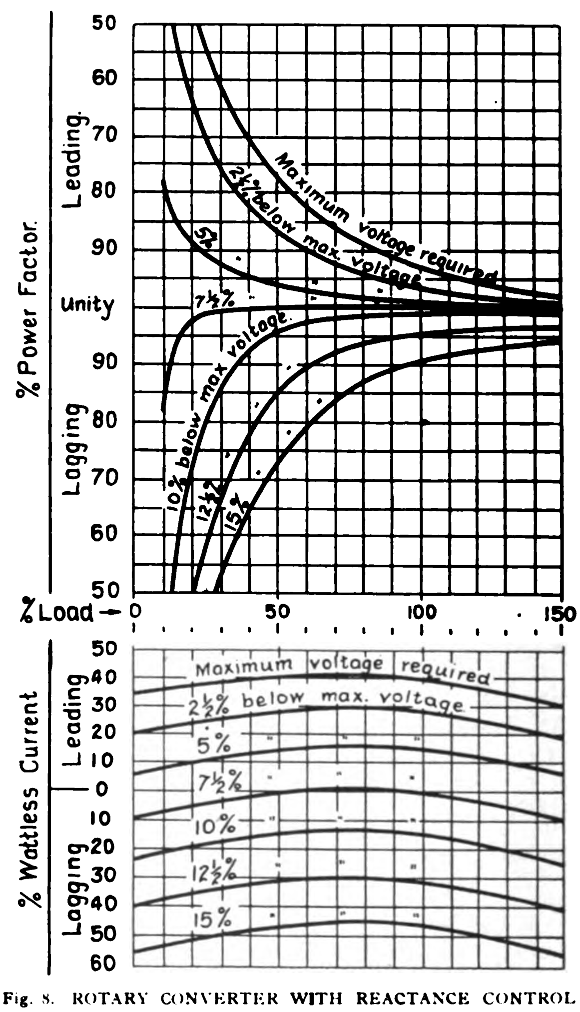


Fig. 8. ROTARY CONVERTER WITH REACTANCE CONTROL POWER FACTOR ON LINE.

enable the rotary converter equipment to run with the above variation in voltage on either lighting or traction bars under the conditions of power factor there given.

Fig. 7 shows the outside limits of power factor that need be required under various conditions of load and voltage with voltage ranges of 0, 5, 10 and 15% respectively, the H.T. taps on the transformer being so set as to give unity power factor at the mean D.C. voltage. Better results than these can be obtained when required.

The curves also give the wattless current (leading or lagging) expressed as a percentage of full load current which will be drawn from the line under the various loads and voltages.

It will be noticed that for a constant voltage the reactance-controlled machine will draw an approximately constant wattless current from the line from no-load to 50% overload. The value of that current, and whether it leads or lags, depends on the setting of the high-tension transformer taps.

Under the conditions shown on these curves, a reactance-controlled rotary will operate with lowest heating and highest efficiency.

It may be desirable, however, to arrange the converter to draw as much leading current as possible, so as to compensate for a low power factor on a certain feeder or at the main station. There is a commercial limit to the amount of leading current that can be drawn, beyond which the rotary is appreciably increased in cost and reduced in efficiency.

Fig. 8 gives the power factor that will be obtained under various conditions of load and voltage, with voltage ranges of 0, 5, 10 and 15% respectively, if the rotary is arranged to draw as large a leading current as is deemed reasonable at the highest required voltage for a standard design of machine.

The percentage of wattless current that will be drawn from the line is also given for the various conditions of load and voltage.

It is always desirable to correct the power factor of a system by a large number of machines drawing a reasonable amount of leading current, rather than penalize one machine by drawing from it alone an excessive amount of leading current.

The reactance-controlled machine will generally improve the power factor of a system (unless it is higher than, say, 85%) even when running on the low voltages, provided the machine is well loaded.

When the higher loads and higher voltages are required on the D.C. end of the rotary, a leading current is drawn which helps to keep up the voltage on the A.C. side. When there is a very light load on the rotary and it is operating at low D.C. voltage, small amounts of lagging current can be drawn from the A.C. side, as this will be lightly loaded, and under such conditions the A.C. voltage will tend to be high.

Fig. 9 illustrates a 1,500-k.w., 375-r.p.m., 500/550-volt, 50-cycle, 6-phase rotary for reactance control.

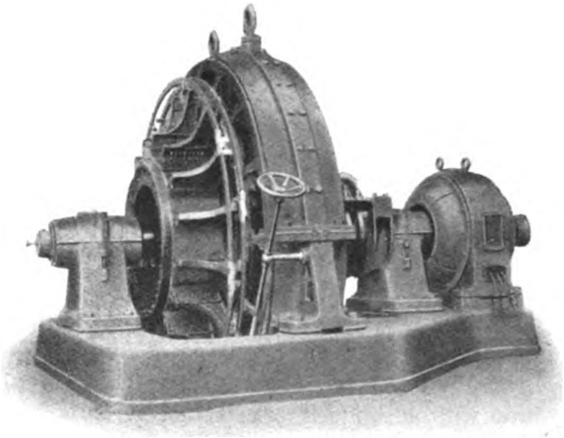


Fig. 9. 1,500 K.W., 375 R.P.M., 500/550 VOLTS, 50 CYCLES, 6-PHASE ROTARY CONVERTER WITH REACTANCE CONTROL, AND WITH STARTING INDUCTION MOTOR.

Booster Control. Rotaries with this control have been constructed for all capacities and frequencies, and are installed where the voltage range required is larger than 10% to 15%, or when independent control of the power factor is required at all loads and voltages.

So long as rotary converters were installed without commutating poles, or of liberal design with commutating poles, the booster converter formed a compact, cheap, reliable and efficient piece of converting apparatus.

With the introduction of commutating poles, however, largely increased outputs were obtained from a given size of machine, and it has been found in such machines that if the booster is used to vary the voltage over wide limits on full load, the commutation is seriously affected.

If the commutation of a booster rotary is set so that it is correct at the mid A.C. and mid D.C. voltage, then when the booster is being used to raise the D.C. voltage, armature currents exist in the rotary which magnetize the commutating poles so that their effect is too strong. When the booster is bucking, armature currents exist which de-magnetize the commutating poles and make them too weak, so that while the booster rotary may operate over small ranges of voltage, with good commutation, if the variation in voltage is large the commutation will be seriously affected.

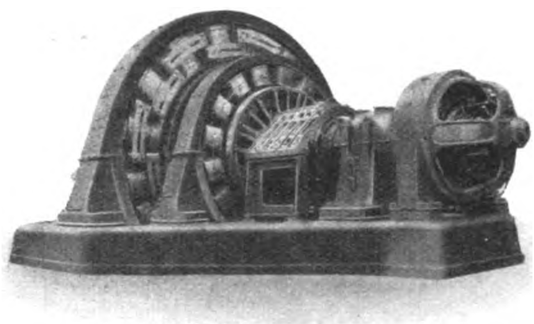


Fig. 10. 1,500 KW., 375 R.P.M., 520/600 VOLTS, 50 CYCLES, 6-PHASE ROTARY CONVERTER WITH BOOSTER CONTROL AND EXCITER.

Various methods have been used to overcome this difficulty :—

(1) Diverters have been arranged so that they can be connected across the commutating poles as the D.C. voltage is increased. When on the higher voltages, the rotary is often running on traction, on which duty diverters may cause a flash-over. This can be obviated by fitting inductive diverters.

The adjustment of diverters, however, especially on machines of large capacities, is liable to alter.

(2) Various schemes of compensation of the commutating conditions have been used in which auxiliary windings have been fitted to the commutating poles, which can be operated with or without contactors in the main D.C. circuit. Many schemes of this nature have been installed on commutating pole booster converters in America, as it was found that these machines would not carry their full load current over the range in voltage specified without these devices.

The foregoing methods of obtaining compensation can be avoided if booster-controlled rotaries are liberally designed ; but when this is done it will often be found that the induction regulator method of control, described later, is preferable and of lower first cost.

Fig. 10 illustrates a 1,500-k.w., 375-r.p.m., 520/600-volt, 50-cycle, 6-phase booster rotary.

Induction Regulator Control. This method of control is similar to booster control, and will perform exactly the same functions, with the important advantage that the factors which control the commutating conditions of the rotary are independent of the amount of voltage variation ; so that machines can be built of the largest output for a given size without diverters or auxiliary windings on the commutating poles, and are capable of 30% voltage variation and even more should occasion arise.

This method of control was widely adopted some years ago, and although considerably more induction regulator rotaries have been installed than booster machines, yet the booster machine eventually superseded the regulator-controlled machine, mainly on account of lower first cost, less floor space and simpler external connections.

Recently, induction regulator controlled rotaries have been produced with the regulator mounted on the rotary base. These take up less floor space, and are of approximately the same cost as the booster machine.

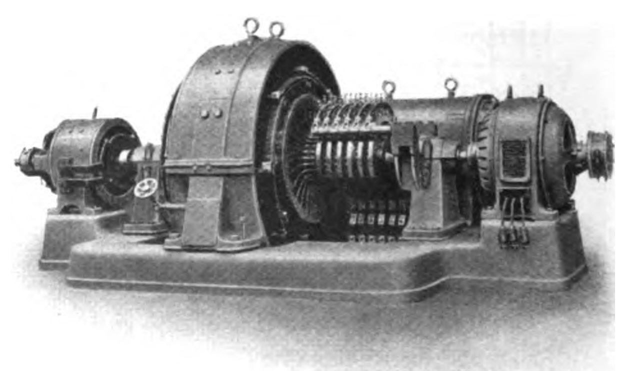


Fig. 11. 500 KW., 750 R.P.M., 500/550 VOLTS, 50 CYCLES, 6-PHASE ROTARY CONVERTER WITH INDUCTION REGULATOR CONTROL AND STARTING INDUCTION MOTOR. ALSO EXCITER FOR INVERTED RUNNING.

The regulator is connected between the A.C. brush holders and terminal board of the rotary, and there are no external connections to the regulator.

The economical design of regulators for larger capacities at first presented some new problems, but these have been solved.

As mentioned previously, such sets have the important advantage that commutation is unaffected by voltage variation, the rotary being of the simplest and most robust design.

Booster or regulator-controlled rotary converters are often installed for correcting a low power factor, the machines being arranged for operating on 90% leading power factor at full load at any voltage.

On large systems machines can be standardized suitable for such regulators; but the latter need only be fitted where the conditions demand it.

Fig. 11 illustrates a 500-k.w., 750-r.p.m., 500/550-volt, 50-cycle, 6-phase regulator-controlled rotary, with starting motor and exciter for inverted running.

Split Pole Control. This method of control has a limited use on 25-cycle systems, and Fig. 12 illustrates a 250-k.w., 750-r.p.m., 180/250-volt, 25-cycle, 6-phase rotary of this type.

REGULATION.

The voltage drop of a shunt-wound rotary converter from no-load to full load with unaltered field rheostat, varies according to size and type of machine from 4% to 10%. Means

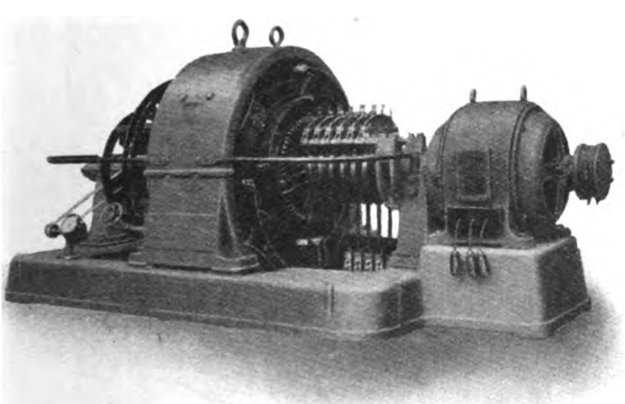


Fig. 12. 250 KW., 750 R.P.M., 180/250 VOLTS, 25 CYCLES 6-PHASE ROTARY CONVERTER WITH SPLIT POLE CONTROL, AND STARTING INDUCTION MOTOR.

are always provided with all forms of control whereby the voltage can be increased or kept constant as load comes on.

Shunt-wound machines are usually installed in power and lighting stations, and for electro-chemical works; whereas for Railway, Tramway and Industrial service, machines are usually compound-wound.

INVERTED RUNNING.

A large number of machines have been installed for running D.C. to A.C.

These have been used to help the A.C. generators at times when the A.C. system has been heavily loaded, to run at week-ends on a small A.C. load when it was not economical to keep a large A.C. generator running, or to run continually inverted on a new A.C. supply until such time as the installation of a larger A.C. turbo-generator was warranted.

For this duty the speed regulation is quite satisfactory, if the rotary is provided with an exciter. A speed limiting device should be fitted to prevent the rotary attaining too high a speed should an excessive lagging current be drawn from the converter, due to a fault on the A.C. system.

Equipments for inverted-running require an A.C. booster or regulator, so that the A.C. voltage can be independently controlled.

Fig. 11 shows a 500-k.w., 750-r.p.m., 500/550-volt, 50-cycle rotary, constructed for running A.C. to D.C., or D.C. to A.C.

THE vitality and energy of millions of people of diverse races and national ideals constitute the British Empire, and they remain part of the Empire ***voluntarily*** to support the principles of Freedom and Self-government. This is the greatest Co-operative Association in history, a voluntary union for a principle. But the principles of the German Empire practically stand condemned to-day before the whole world. All unity is maintained by intelligent co-operation; blind, brute-like egoistic aggression cannot sustain any association of men for long.

MANUFACTURERS' SECTION

BERRY, SKINNER & CO.

Those station engineers who have devoted their attention to the supply of current at the cheap rate for cooking purposes have declared certain essentials regarding the construction of switching gear for the control of cooking outfits.

The switch and fuses must be self-contained, of small compass and of neat construction, in order that their appearance may not be unsightly when installed in the kitchen. More important still, they should be fool-proof and of such a character that it is impossible for an unskilled person to obtain shock when operating or replacing a fuse. The switch case should be constructed of metal and the insulating portions of mica, the apparatus being capable of carrying, without over-heating, the maximum current for which it is rated. A ruby signal should be provided to indicate should the cooking elements be left switched on when not actually required.

Messrs. Berry, Skinner & Co., of 78, Upper Thames Street, E.C., have produced a Combined Switch Fuse which fulfils all these requirements and we give an illustration of the apparatus herewith. It will be seen from the illustrations that the apparatus is extremely compact. It is mechanically strong in construction and leaves nothing to be desired from an electrical point of view. By actuating the side lever handle to the " on " position a ruby reflex indicator is brought into full view, immediately denoting that the apparatus is alive. Upon removal of the switch handle to the " off " position this ruby indicator drops, and a green glass indicator is automatically shown. This feature is a decided improvement upon the provision of a carbon lamp attached to a small bracket :—

Firstly, the reflex indicator is a non-current consuming device—an important feature from the consumer's point of view.

Furthermore, it is purely a mechanical device and the consumer is not dependent upon the life of a lamp filament for guidance.

If preferred, the reflex indicator can be fitted to the oven or other cooking apparatus and controlled by actuating the switch by means of a connecting wire on the Bowden Brake principle. This type of indicator cannot get out of order and is decidedly smarter in appearance than the bracket and ruby lamp.

Fig. 1.

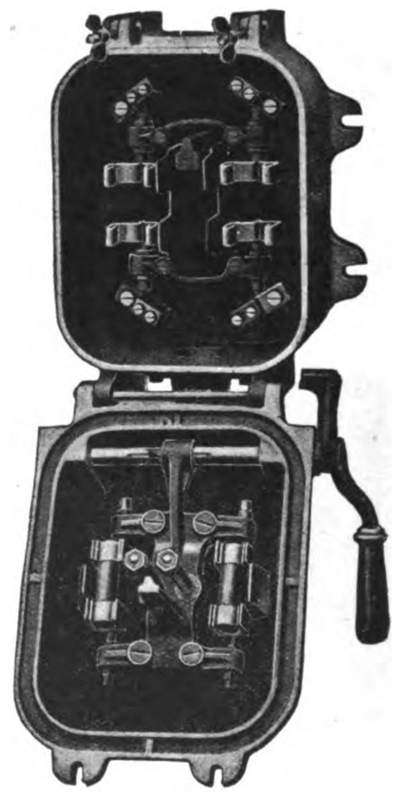


Fig. 2.

A second illustration gives a fair idea of the internal construction of the switch fuse. It will be noted that should a fuse require replacing, the fuse-carrying gear is well away from live terminals and one is free to handle the necessary parts of the apparatus without coming into proximity with live parts.

BRITISH THOMSON-HOUSTON CO., LTD.

TRUCK TYPE IRONCLAD SWITCHGEAR.

For Polyphase Systems up to 11,000 Volts.—This gear has been developed by the British Thomson-Houston Co., Ltd., Electrical Engineers and Manufacturers, of Rugby, in view of the increasing use of three-phase extra high-pressure alternating current, for distribution by power supply companies to sub-stations.

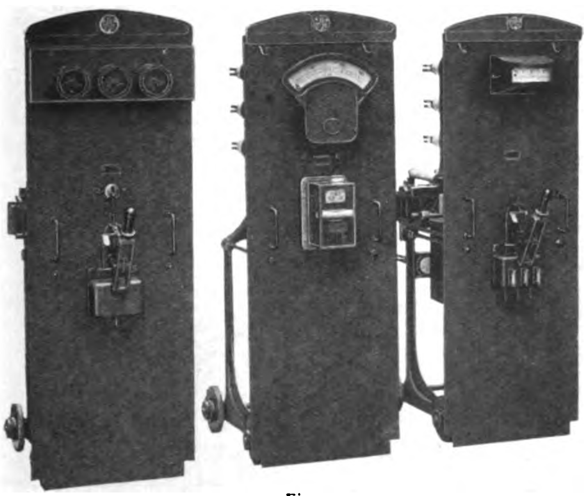


Fig. 3.

FRONT VIEW THREE TRUCK TYPE PANELS.
FEEDER, BUS BAR & TRANSFORMER PANELS.

The apparatus is especially suitable for this service, as it is well protected, occupies a minimum of space and is of substantial construction.

Panels are offered also for two-phase, 2,000, 4,000 and 7,000-volt service, and for high-pressure (2,200 volts) three-phase service; the three-phase extra high-pressure panels being suitable for 3,300, 5,500, 6,600 and 11,000 volts.

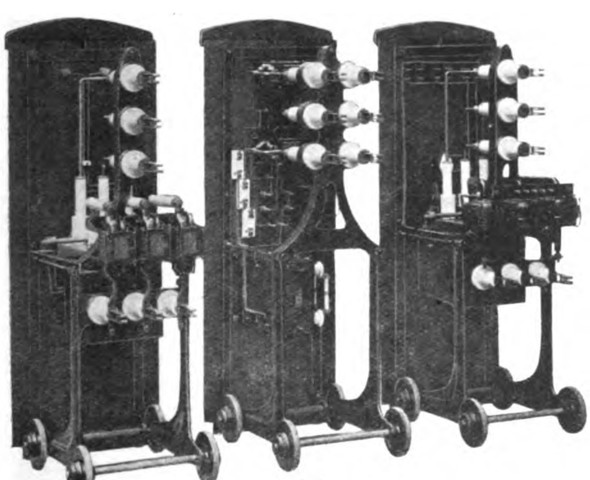


Fig. 4.

BACK VIEW OF THREE TRUCK PANELS.
TRANSFORMER—BUS BAR—FEEDER PANELS.

General Construction.—The high-tension apparatus is completely enclosed in a substantial iron structure, arranged so that it can be mounted against a sub-station wall, access to all parts of the switchgear being given from the front.

The whole of the apparatus, connections and small wiring, with the exception of the bus bars and cable bells, are mounted on a movable truck. On withdrawing this truck, access is obtained on three sides, thus fully exposing every part. The truck may be withdrawn in the space allocated to the attendant in front of the panels, and may then be wheeled into any position.

The truck carries contact jaws mounted on porcelain insulators which engage with contact blades mounted in the fixed portion of the structure. These contact blades are sunk into the porcelain insulators so as to obviate danger of accidental shock or short circuits when the truck is removed. The same insulators also support the bus bars in the bus bar chamber and the cable terminals in the cable box chamber.

A locking device is provided to prevent the plug contacts being closed or separated except with the oil switch in the off position.

All parts are held together by means of bolts and lock nuts, so that any part can be readily removed and replaced in a sound mechanical manner. No bitumen, rubber or other inflammable insulation is used.

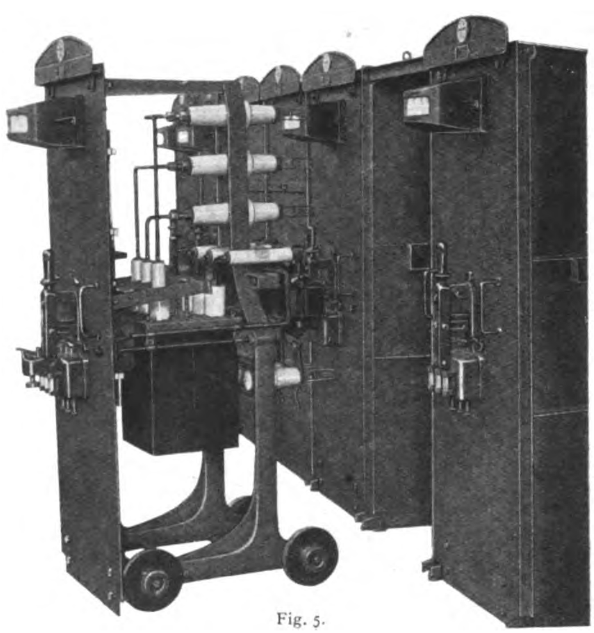


Fig. 5.

B.T.H. TRUCK TYPE SWITCHGEAR.
VIEW SHOWING TRUCK REMOVED.

The small wiring between the current transformers, trip coils and instruments is permanently connected up and mounted on porcelain insulators attached to the frame of the truck.

The whole gear is arranged so that ample clearances are allowed between the conductors, and from conductors to earth.

The oil switches are designed to carry 250 ampères and to open a dead short circuit on a 11,000-volt plant where the short circuit current does not exceed ten times this figure.

Where, owing to the proximity and size of the generating plant, the maximum short circuit current may exceed this figure, the oil switch may require support from feeder switches nearer to the source of supply.

Merz-Price protective apparatus can be fitted if required, or B.T.H. leakage protective devices can be supplied for disconnecting independent circuits in the event of faults developing in them. Reverse current relays can be supplied for cases where the use of such apparatus is advisable.

SELECTION OF EQUIPMENT.

Rating of Panels.—The ampère ratings given to the panels are the maximum currents which they are designed to carry continuously. The instrument scales are selected to allow for temporary overloads above these figures.

In selecting a panel for a machine or transformer, the current capacity of the panel chosen must be based on the ½ to two hours overload guarantee of the machine or transformer. Generators will usually carry 25 per cent. overload for ½ to two hours at 50 per cent. power factor.

The current rating of feeder circuits will be taken as that corresponding to a density of 1,000 ampères per square inch. In cases where feeders are to be run at higher densities to obtain maximum output, or where they will be underloaded for some time and it is desired to employ lower instrument scales and settings on converter circuits. They are furnished only for polyphase circuits. Standard power factor indicators are made with either one or two series coils ; the former can be used where three-phase potential transformers are installed, and the latter where single-phase potential transformers are used. The extra cost of the two-series coil instrument is more than compensated by the saving on the potential transformer, but this instrument is only suitable for balanced loads.

Integrating Wattmeters.—The output is generally metered at the main station but wattmeters may be used for individual circuits in sub-station equipments. It is generally desirable to meter individual machine circuits rather than feeder circuits, as the load factor on the latter is so low that metering cannot be so accurate as on machine circuits.

Voltmeters.—Machine voltmeters on small boards are best mounted next to the synchronizing gear, but

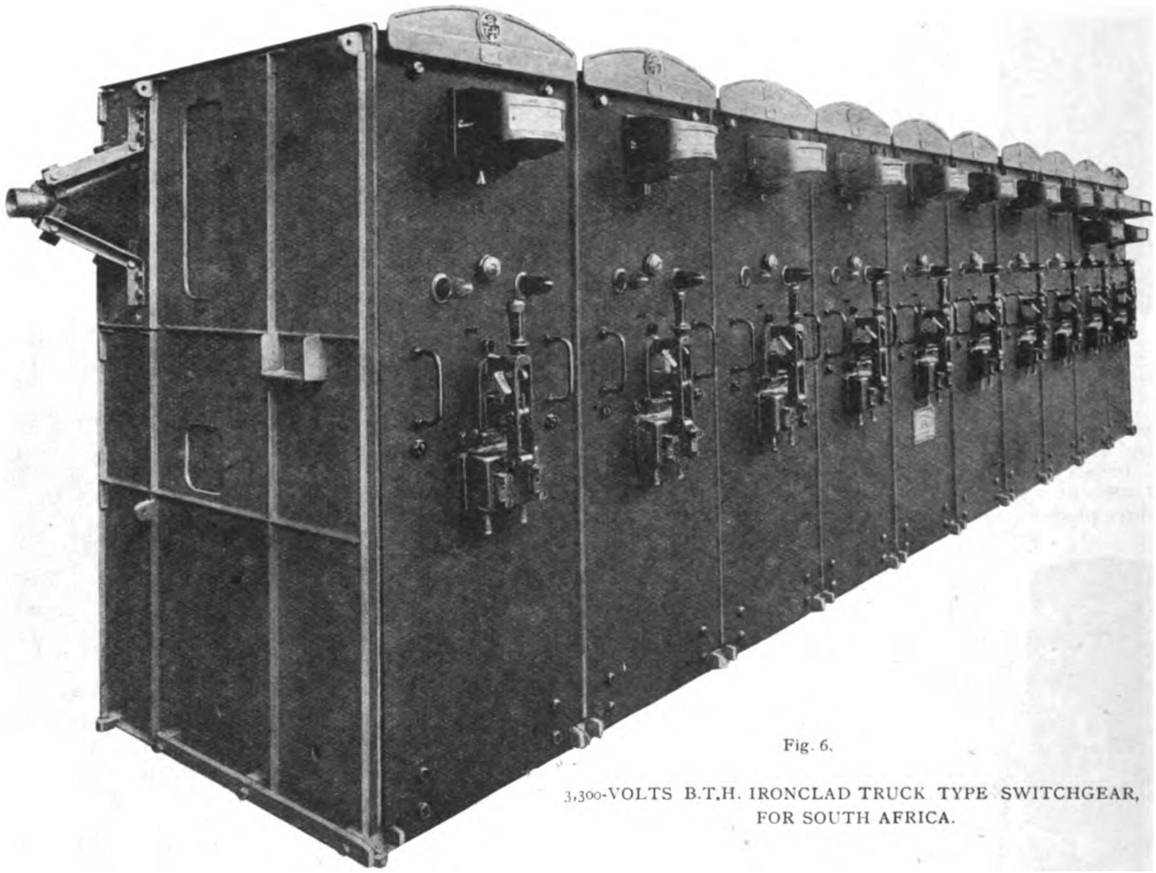


Fig. 6.

3,300-VOLTS B.T.H. IRONCLAD TRUCK TYPE SWITCHGEAR, FOR SOUTH AFRICA.

automatic devices, the required rating must be stated when ordering.

INSTRUMENT AND PROTECTIVE EQUIPMENT.

Ammeters.—It is customary to employ an ammeter on every circuit to indicate the amount of current passing, which is the determining feature of the heating of the circuit.

Indicating Wattmeters.—The indicating wattmeter gives a direct indication of the power taken by the circuit. The instrument furnished for truck panels has a polyphase winding giving accurate indications on balanced and unbalanced circuits, and giving legible readings on low loads.

Power Factor Indicators.—If indicating wattmeters are used power factor indicators can be dispensed with, but they may be used advantageously on circuits where the power factor can be varied, as on rotary voltmeters supplied for individual incoming feeders (and mounted on the corresponding panels) will be connected to the feeder side of the oil switch, so as to indicate if the feeder be alive from the main station.

Synchronism Indicator.—This instrument is generally connected up so that any two circuits may be connected to it for synchronizing one with the other, thus avoiding the necessity of providing bus bar potential transformers and means for inspecting same whilst the bus bars are alive.

Overload Devices.—Provision is made in all cases for the use of time limit fuses in shunt to the overload trip coils. These prevent the unnecessary disconnection of circuits on momentary overloads.

Leakage Protective Devices.—Where the midpoint of the system is earthed the B.T.H. patented system of connections may be employed, by means of which the automatic trip operates instantaneously

at a fraction of normal load current, on faults to earth; and at the same time the full benefit of the time limit fuses is available to prevent the operation of the automatics on a momentary overload.

REVERSE CURRENT RELAYS.—The reverse relays offered are unaffected by forward current of any magnitude or by sudden changes of current. They are operative on voltages down to 10 per cent. of normal voltage, but if employed in a sub-station having running machinery capable of feeding back into a fault they may operate when a heavy fault occurs elsewhere on the system.

MERZ-PRICE APPARATUS.—This apparatus is employed in conjunction with pilot wires laid parallel to the feeders to be protected and serves to disconnect a faulty feeder independently of voltage and phase conditions and without disturbance to sound feeders.

Truck type Ironclad Switchgear has been supplied by The British Thomson-Houston Co., Ltd., of Rugby, to many colonial installations and is giving complete satisfaction.

BRUSH ELECTRICAL ENGINEERING CO., LTD.

Illustration No. 7 shows a typical squirrel-cage induction motor of standard backgear design for textile mill driving, manufactured by the Brush Electrical Engineering Co. at their Falcon Works, Loughborough, who have specialized on this class of work. It is one of the smaller size machines and part of an order for twenty machines (of different sizes) recently executed for one mill. The particular machine shown was designed for an output of 25 h.p. 400 volts 960 r.p.m. on a three-phase, 50-cycle circuit, the backgear giving a speed reduction of 960 r.p.m. to 240 r.p.m. The backgear shaft is carried in two self-oiling ring lubricated plummer blocks mounted on the end frames.

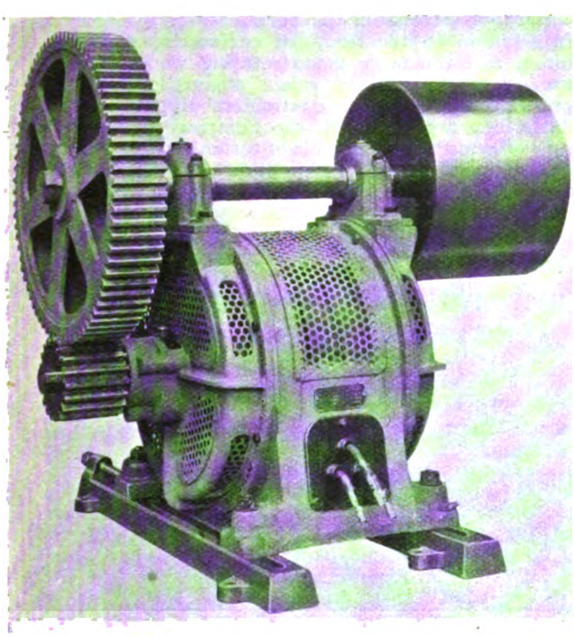


Fig. 7.

The photograph clearly shows the standard ½ in. mesh perforated covers which have been found satisfactory in guarding against the ingress of fluff into the working parts. The machine complies in every way with Home Office regulations in respect to textile mill driving.

The starting of the motor is accomplished by a suitable auto starter which, on a mid tapping in conjunction with the motor, gives a starting torque with ample margin over that actually required.

MESSRS. CROMPTON & CO., LTD.

Messrs. Crompton & Co., Ltd., of Chelmsford, have given special attention during the past few years to the design and manufacture of single and polyphase alternators. These machines are now standardized in all sizes up to about 3,000 K.W. and are suitable for working with all types of gas, oil, steam and water prime movers.

The alternators are of the revolving field radial pole type, the coils being securely held in position by means of the pole shoes. The armature stampings are built up with the aid of special jigs, which ensure that the stampings are correctly aligned with the slots parallel, thereby avoiding all unnecessary filing and the usual

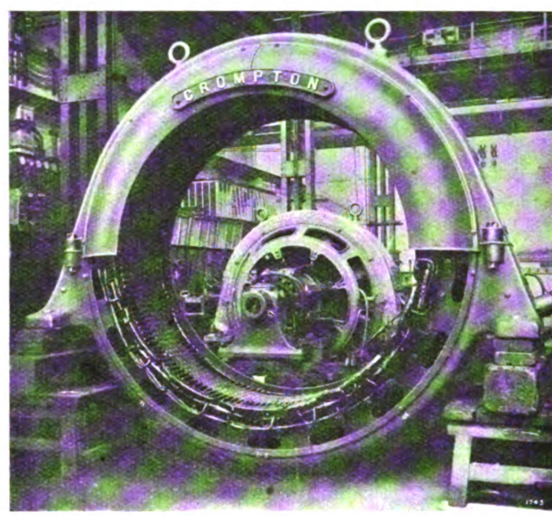


Fig. 8.

iron losses resulting from this filing operation. The stampings are supported in a cast-iron frame of special design, resulting in an efficient ventilation thus being obtained in all parts of the core.

This question of ventilation is an exceedingly important one and has received the careful study of Messrs. Crompton & Co., Ltd., and it may be added that the cast-iron guards which protect the ends of the coils also play a prominent part in the scientific ventilation of the machine.

When the stationary armature coils are former wound for use in slots of the open type, they are in every size solidly impregnated with insulating varnish under pressure. The coils are held in position by dove-tailed wooden wedges inserted from each end of the slot and it is quite a simple matter to readily replace a coil should it be necessary to do so.

These alternators embody all the latest improvements in design and are manufactured on the most up-to-date and approved methods of construction. The temperature rise has been found to be very low on all machines of this design owing to the entire absence of any air-pockets or restricted ventilation on the machine; the efficiency is also high and a very satisfactory regulation is obtained in all sizes.

The armature of a large 3-phase alternator is illustrated in Fig. 8, which shows clearly the protection

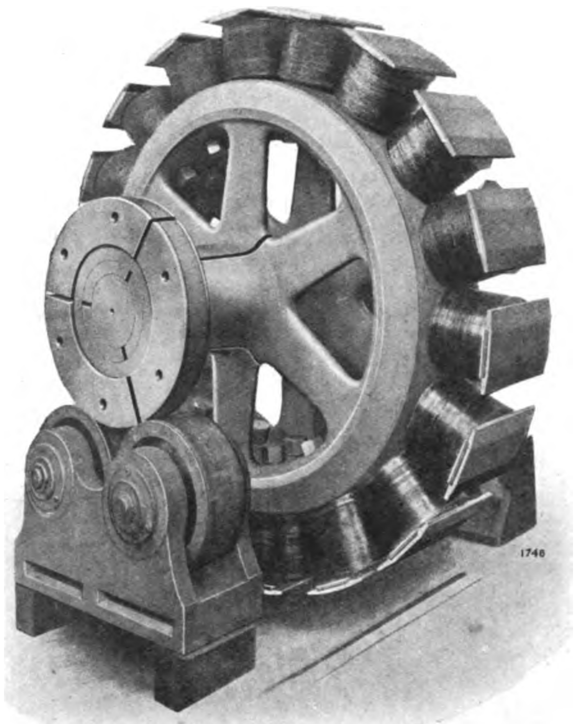


Fig. 9.

afforded the ends of the windings by means of the end guards, the lower guards being removed for the purpose of the illustration. The revolving field system with radial poles of this particular machine is illustrated in Fig. 9. The alternator represents part of a large order for plant to be used by a mining company for munition work.

In the main advertisement of Messrs. Crompton and Co., Ltd., printed on another page, a view is given of a medium size generating station with Diesel engines driving H.T. 3-phase alternators. A view is also shown of the controlling switchboard. This plant is typical of many others put down by this firm for public supply work, and mention might be made of Sevenoaks, Ahmedabad, Egham and Staines, Fareham, Madras, etc,

times as many as 1,200 native "boys" were engaged on the work.

Other works of a civil engineering character recently carried out by this firm are the construction for the Metropolitan Water Board of a reservoir near Staines to hold 7,000,000,000 gallons of water, and also a pumping station at Walton to deal with 130,000,000 gallons of water a day. This latter contract included the construction of a conduit 1,800 feet long involving the excavation of about 60,000 cubic yards of earth.

One of the most interesting of recent contracts completed by Messrs. Dick, Kerr & Co. is the construction and equipment of the experimental tank at the National Physical Laboratory. By means of this tank the Institute of Naval Architects propose to carry out experiments connected with marine propulsion and allied problems. Work of this character involves a very high order of skill and experience in civil, mechanical and electrical engineering. As an instance of the exactitude of the work, it may be mentioned that the maximum deviation of the rails on which the towing carriage runs is less than 1/50th of an inch from dead level.

In purely electrical engineering work Messrs. Dick, Kerr & Co.'s name is world-wide and is probably best known in connection with electrical tramway enterprises, and it would be difficult to find a tramway system in the British Isles in which they have not had a hand. Overseas work of this character with which they have been connected are the tramway systems in Calcutta, Mandalay, Singapore, Japan, the Argentine, etc.

In their electrical engineering works at Preston are manufactured a range of machines varying from tramway motors to large generators, such as 9,000 KVA. slow-speed alternators for the Electric Railways in Vancouver, British Columbia.

Unique of its kind is the short electrified line near Bury of the Lancashire & Yorkshire Railway. This work, which was carried out entirely by Messrs. Dick, Kerr & Co., was on the trolley system, the voltage on the catenery trolley wire being 3,500 d.c., the highest direct-current voltage ever employed for the operation of any railway motor in the world.

In addition to the electrical engineering works at Preston, and the large manufacturing works at Kilmarnock, where narrow gauge steam locomotives, electric locomotive bodies, contractors' tipping wagons and the like are produced, the Company possesses a lamp works in Preston capable of turning out 2½ million metal filament lamps per annum. No Continental firm can show such a wide range of engineering activity as this British firm.

DICK, KERR & CO., LTD.

Amongst the manufacturing firms in Great Britain who carry out complete contracts involving civil, mechanical and electrical branches of engineering is the well-known firm of Messrs. Dick, Kerr & Co., Ltd. During the past fifteen years their name has been so much to the front in electrical engineering matters that their work in civil and mechanical engineering directions has not been so often noted, although they are constantly occupied with this branch. They have recently completely equipped the Government Railway in Portuguese East Africa between Mormba and China vane. The approximate length of the line is 90 kilometres and the gauge 3 ft. 6 in., the standard gauge in Mozambique. The construction of the work involved the construction of twenty-three culverts and bridges and the clearing of a dense bush, which for a considerable distance is entirely waterless, necessitating the carting by ox wagon of every drop of drinking water from the Komati river, several miles distant from the line. The magnitude of the task is indicated by the fact that at

THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.

ARC INCANDESCENT LAMP.

Fig. 10 shows the actual lamp, Fig. 11 lamp connected to resistance, and Fig. 12 the diagram of connections.

An entirely new departure in electric lamp construction has just been put into practical use by The Edison and Swan United Electric Light Co., Ltd., in the form of a high efficiency tungsten arc lamp. The inventors are Messrs. E. A. Gimingham and S. R. Mullard, and the whole of the experiments have been carried out in the Ediswan Laboratories.

The first illustration shows a continuous current type of lamp suitable for use on circuits up to 250 volts where about 100 mean spherical candle-power is required

Three leads are taken through the lamp stem; on one is mounted the electrode "E," while the other two hold the filament, acting as an ionizer B, B1. Positive lead divides into two circuits, A through a resistance and a normally off push switch to one pole

of the ionizer B, the other through a resistance to the positive electrode of the arc circuit E. The negative lead is taken to the ionizer lead B1. The lamp is filled with nitrogen or argon.

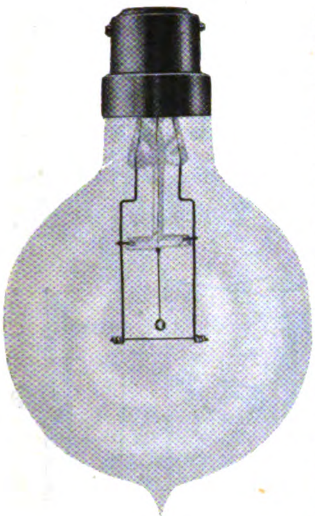


Fig 10.

To start the lamp the push switch is depressed and current passing through the ionizing circuit raises the ionizer B.B1 to incandescence at a temperature sufficient to ionize the gas between it and the positive electrode E.

The push is almost immediately released, one or two seconds being sufficient for ionization, and on the breaking of the ionizer circuit the arc is struck between the electrode E as anode and the filament C as cathode. The heat rising from the arc causes the expansion strip F, connecting the tungsten electrode E to its stem lead, to warp, and the arc moves to another position on the ionizer.

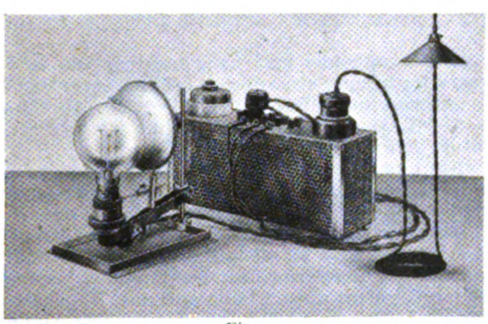


Fig 11.

At the point where the arc strikes the filament the ionizing properties are weakened, but when the lamp is switched off the expansion strip cools and brings the electrode back to a position opposite the filament where the ionizing properties are still active. The arc can thus be always easily started throughout the life of the lamp.

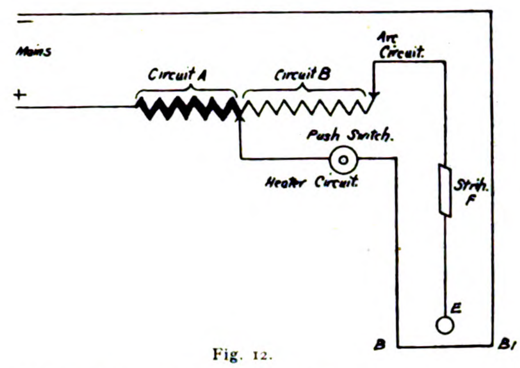


Fig. 12.

The features of this lamp are :—

(1) The intensity of illumination of the arc as shown by comparison with the intrinsic brilliancy of other light sources.

		Intrinsic brilliancy.
Carbon Filament Lamp	(3·5 watts per C.P.)	375 C.P. per sq. in.
Metal ,, ,,	($1\frac{1}{4}$,, ,,)	800-1000 ,,
,, gas ,, ,,	($\frac{1}{2}$ watt ,,)	3500 ,,
Arc incandescent ,,	($\frac{1}{2}$,, ,,)	12,000 ,,

(2) The light is hardly distinguishable from daylight, which for colour matching is of considerable advantage.

SUGGESTED USES.

On continuous current circuits for purposes where a concentrated light is required, as for optical projectors, kinematograph and ordinary lantern work, microscope illumination, micro-photographic work and photographic work generally, small searchlights, signalling and such purposes.

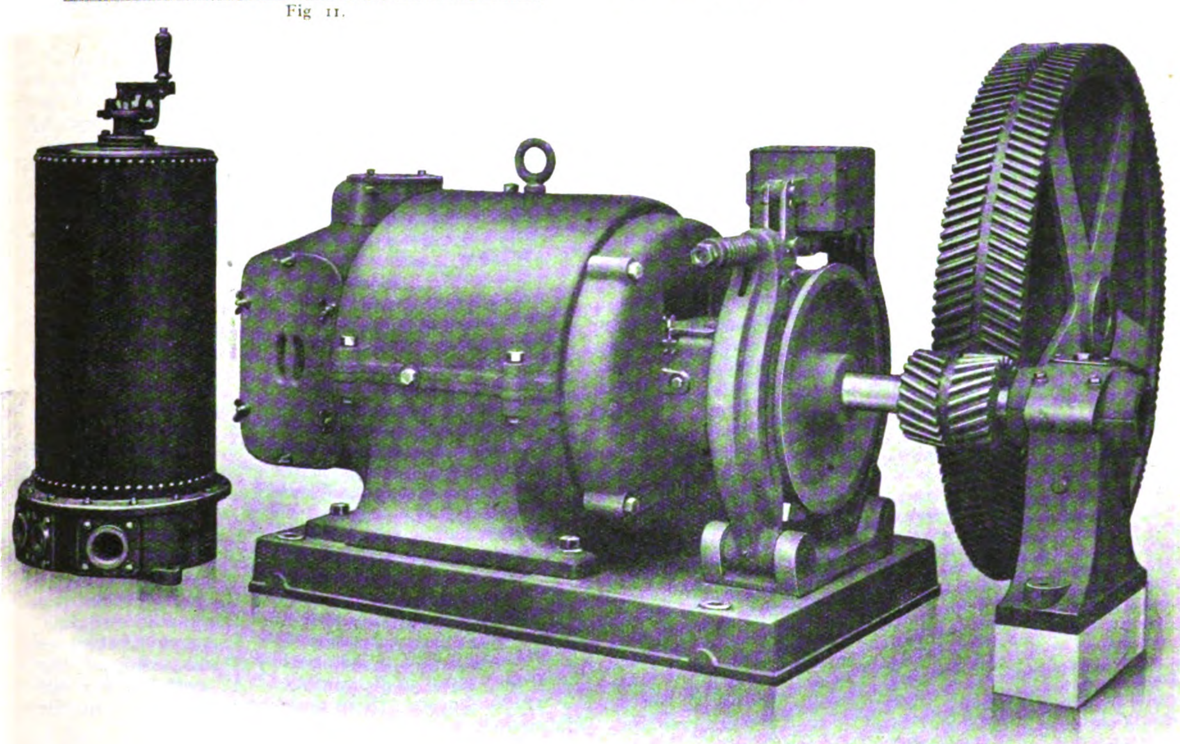


Fig. 13.

ELECTROMOTORS, LIMITED.

The use out-of-doors of electric motors is on the increase, and an illustration is given herewith of a type of machine designed to withstand the roughest weather without any additional protection.

The illustration (fig. 13) is of a 40-horse power motor running at 300 revolutions per minute, which was used for the conversion of a haulage gear and is of the entirely enclosed and water-tight pattern.

The chief feature of the machine is that packed joints are used throughout without in any way interfering with easy access to the machine.

The doors over the commutator are of large size, having wing nuts to hold them in position and with a rubber gasket to prevent any possibility of moisture getting in.

The terminal box is cast solid with a commutator end bearing, so that the terminals are virtually self-contained in the motor case. A lid is provided over the top of the box also fitted with packing, and the design of the terminals is such that all connecting and disconnecting is very simply carried out in this box. The inlet for the cables is screwed to take a standard tubing.

The bearings are exceptionally large in size, being 2½ diameters long and having two oil rings to each bearing, and it will be observed from the illustration that the lids are screwed down into position by wing nuts, and like the other joints are packed.

A. P. LUNDBERG & SONS.

Said the turbo to the tumbler,
" You're a little chap, it's true,
And on my most extensive back
I could take a lot of you."

Said the tumbler to the turbo,
" If numbers count at all,
My fellows congregated
Would make you look quite small."

SINGLE-WAY, "TWINOB," AND D.P. AND T.P. TUMBLER SWITCHES.

The point of the above verses is that a tumbler switch by itself may to some seem one of the most

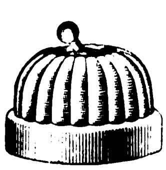


Fig. 14.

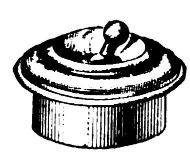


Fig. 15.

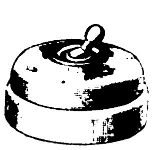


Fig. 16.

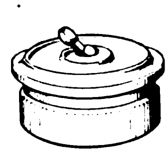


Fig. 17.

insignificant of electrical articles. It is only when one reflects that there are innumerable groups of them doing duty as " operating levers " in the houses of the army of consumers on any given system, that their importance becomes fully manifest.

Imagine to yourself this army of consumers (and the various members of their households, or staffs, etc.,) operating these levers millions of times every week or (in some cases) every day.

The switches may be otherwise likened to connecting links between the consumers and the supply system; and the efficiency and financial success of the system as a whole depends to an appreciable extent on the durability and smooth working of these links or levers.

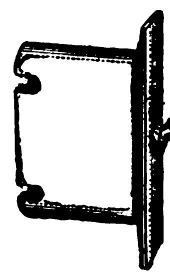


Fig. 18.

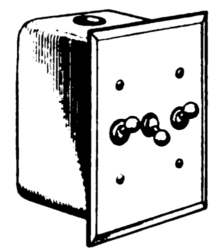


Fig. 19

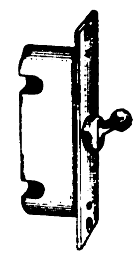


Fig. 20.

A cheap lampholder may hang together and do duty for years, for in some situations it is hardly ever touched. Most switches in an installation, on the other hand, have to withstand repeated (and not always gentle) operation daily.

A cheap switch will soon lose its " sweetness " or smoothness of action, assuming it had these qualities to start with; will become a nuisance to the touch, and will eventually rattle itself to pieces and need replacement. Except that an installation could not fall to pieces, the use of inferior switches might be compared to the employment of bad bolts and nuts on a piece of machinery. The good working of the whole would be affected by this ill-advised economy.

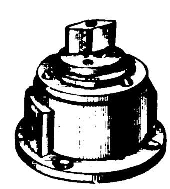


Fig. 21.

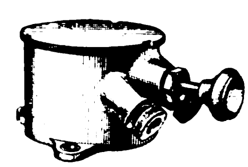


Fig. 22.

The fact that one has to pay a reasonable price for the tumbler and other small switches made by Messrs. A. P. Lundberg & Sons (477/489, Liverpool Road, London, N., England) may be accepted as part proof of their thoroughly good construction, reliability of action and endurance; and those who are interested in these goods should send in at once for a copy of the firm's new cloth-bound 86-page " List 1."

In spite of its size, this improved list (which is the forerunner of others) deals only with Single-way " Twinob " and Double-pole and Triple-pole switches. Nevertheless, as the single-way switches themselves run to some thirty different patterns, and as the " Twinob " and single-tumbler D.P. switches are not too widely known, there is plenty of novelty in the publication.

It should be noted that "patterns" have reference to actual differences in form and construction, not merely to the superficial matter of covers—of which several varieties are available.

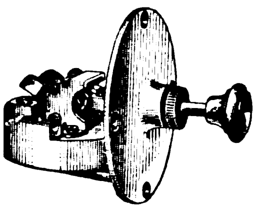


Fig. 23.

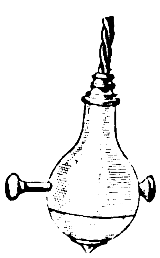


Fig. 24.

Fig. 25.

Though Figs. **14** and **15** may seem to represent just ordinary forms of single-way surface and flush switch, in the Lundberg series of this type these figures stand for the "Pivot" (with ordinary or Admiralty-pattern terminals) and "Bi-path" constructions, each of which has various modifications. "Imp" flat surface and flush switches are shown in Figs. **16** and **17**; and

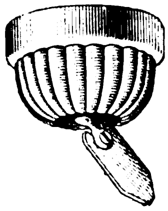


Fig. 26.

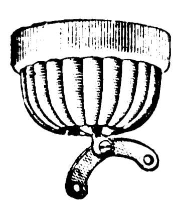


Fig. 27.

"Klymax" and "Mortise" flush-panel switches in **18** and **20**. Fig. **19** illustrates how "Klymax" switches may be grouped. Figs. **21** and **22** show two widely-different forms of water-tight switch, the latter being the "Neptune" Admiralty pattern, with quick-make-and-break and push-and-pull operation. Fig. **23** is a modification of Fig. **22**, and is largely used with big heating

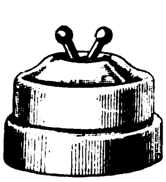


Fig. 28.

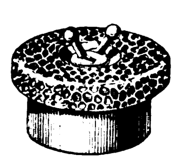


Fig. 29.

Fig. 30.

apparatus. It is also suitable for switchboard work. Figs. **24** and **25** illustrate two forms of pendant switch, while Figs. **26** and **27** show modifications for allowing of trigger and cord-pull operation.

Although the "Twinob" switch (Figs. 28, 29, 30) is at first sight merely an exceedingly useful combination of two switches on one base, the numerous modifications (in construction or connections or in both) enlarge its field of service to a surprising extent. The control of small 3-phase motors or heaters is one example. One of the modifications is shown in Figs. 31 and 32, and this (with slight internal modification in one case) enables the switch to be used as a single-tumbler D.P. switch, as a quadruple-break single-way switch, as a double capacity single-way switch, as a pilot switch, or as a simultaneous two-way-off switch. It will surprise some people to learn that each of these types or sub-types has definite uses.

Though two-way switches will be included with other special types in the forthcoming List 2, the difference between their prices and those of kindred forms of single-way switch are given in the List 1 under notice.

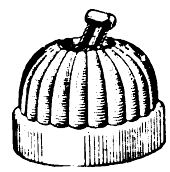


Fig. 31.

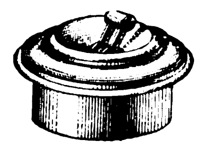


Fig. 32.

Anyone desirous of investigating on paper the remarkably interesting and practical uses to which tumbler switches (especially of so-called "special" types) may be put, should write Messrs. A. P. Lundberg & Sons (477/489, Liverpool Road, London, N.), about their periodical Electric-light Switching Competitions.

MATHER & PLATT, LTD.

An outstanding feature of present-day electrical engineering is the specialization which has occurred as a natural outcome of the diversity of purposes to which electricity is applied. Messrs. Mather & Platt, Ltd., of Park Works, Manchester, have particularly associated themselves with what may be called "heavy electrical engineering," *i.e.*, the construction of generators and motors for all purposes up to the largest sizes, and the accompanying illustrations, taken at random as they are from many contracts carried out in all parts of the world, will no doubt be of interest.

A good example of a slow-speed direct-current generator driven through gearing by a high-speed steam turbine is shown in Fig. 33. The electrical portion of the set has been supplied by Mather & Platt, Limited, and consists of a shunt-wound interpole type generator designed to give continuously an output of 9,200 ampères at 135 to 150 volts when running at about 250 r.p.m. In view of the exceptionally heavy current to be dealt with, and of the arduous duty of the machine, *viz.*, full load for twenty-four hours per day and seven days per week, liberality in design, both from the electrical and mechanical standpoints, was essential. The machine is provided with two pedestal bearings mounted on a substantial cast-iron bedplate, and the shaft and bearings are of unusually large dimensions. The most difficult problems in the design of such a machine centre round the commutator and brush gear. The latter must be so constructed as to avoid vibration, and in this case the whole of the mechanism is carried by

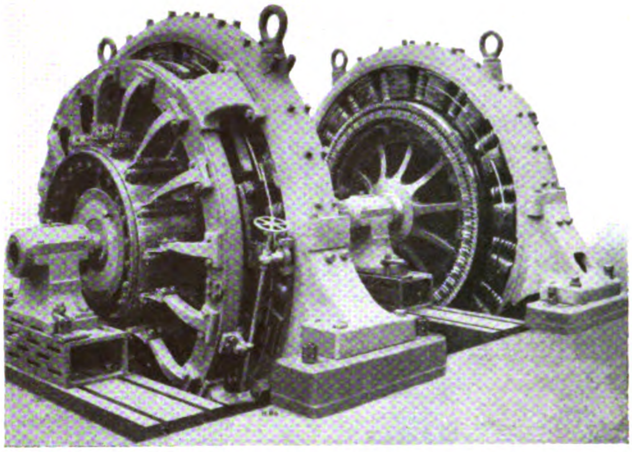


Fig. 33.

an independent yoke, supported by the bedplate. For chemical works, etc., special attention is required with regard to the insulation.

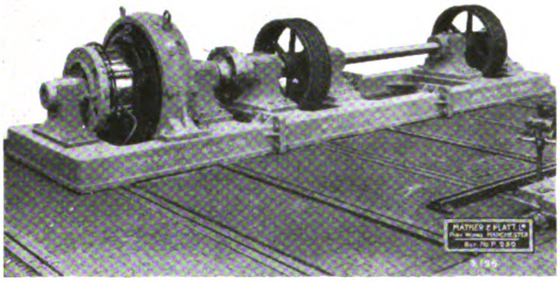


Fig. 34.

Fig. 34 illustrates a 300 B.H.P. slow-speed motor for rope driving a very heavy rock crusher. The substantial character of the bearings, bed and shaft should be noted. The machine is very liberally rated and, like all the D.C. machines turned out by this firm, is fitted with commutating poles.

An interesting example of weaving shed driving is shown in Fig. 35. This is only a portion of a complete installation erected in India, comprising the electric driving of spinning, weaving and auxiliary machinery. The motors shown drive the line shafting through self-contained double helical gears with flexible couplings on both high and slow-speed shafts. The motors are of the totally-enclosed, pipe ventilated type, pipes being connected to the "inlet" and "outlet" openings of the end covers to allow of clean, cool air being circulated through the motor.

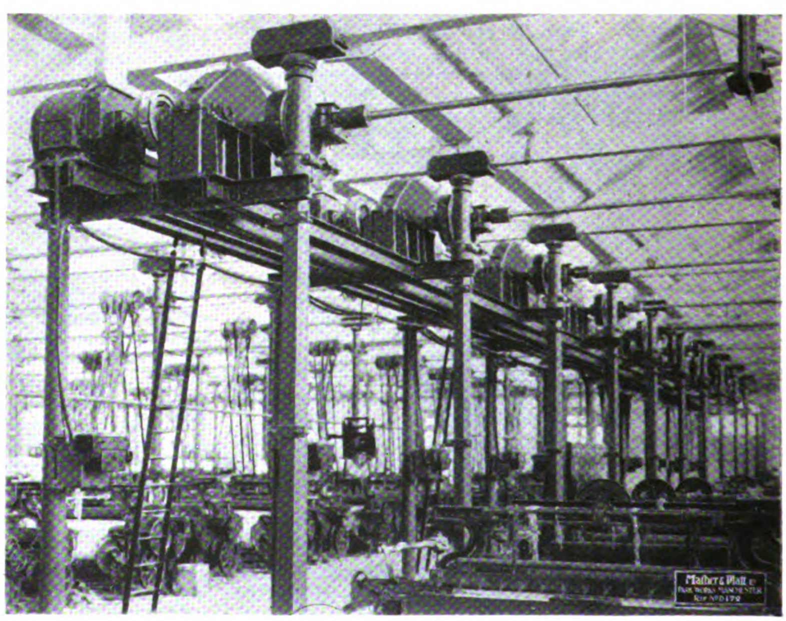


Fig. 35.

In the same mill an electrically-driven turbine pump and motor is used for boiler-feeding purposes.

ELECTRIC TRAIN LIGHTING.

Mather & Platt, Ltd., are the makers of, and have supplied extensively to railways all over the world, an electrical system of train lighting, presenting at once many striking advantages over lighting by gas or oil.

Railway systems using gas find that the annual expenditure for upkeep of machinery, wages of a large staff of attendants, and repairs and renewals, reach quite a substantial figure. The cost of coal used in producing the gas is also an item of no less importance. The risk of fire attendant on the use of cylinders filled with inflammable gas under pressure is so well known as to need no comment, as, almost without exception, when a collision of a serious nature has taken place, fire fed by the escaping volumes of gas has added largely to the loss of life and property.

The electric light on the other hand, is practically free from any risk in respect to fire. The voltage used is low, the total capacity of the batteries carried is not great, and in the event even of a complete shattering of the coach the independent elements of the system are unlikely to originate a fire, and quite incapable of augmenting one should it be otherwise started.

The dynamo, which constitutes the essential feature of their system of train lighting, has inherent properties of such a nature that, no matter how the speed may vary above a certain pre-determined limit, its voltage remains to all intents and purposes perfectly constant, and would retain this characteristic till the speed reached infinity, did mechanical considerations permit of such a test being made.

The dynamo regulates automatically, without the use of any external regulating "devices" whatsoever; the direction of its voltage is constant and independent of the direction of rotation of the armature, thus dispensing with the necessity for any form of pole changer. No compound windings for de-magnetising

purposes, nor shunt resistances with sliding contacts, are required. The belt tension is normal, and the slip therefore only such as is usual with any belt-driven machine. The dynamo may consequently be suspended directly from the coach bogie (see Fig. 36), thus avoiding distortion and fraying of the belt when negotiating curves.

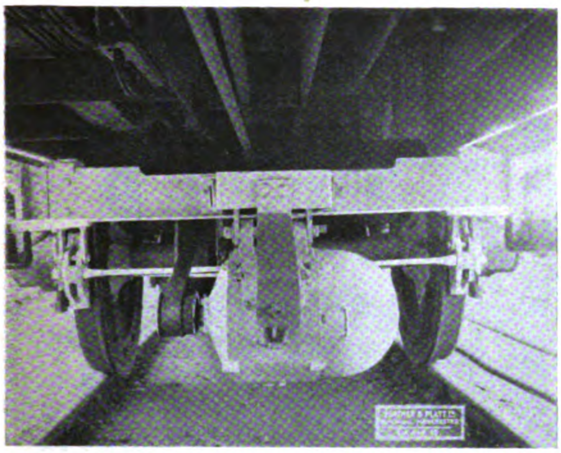


Fig. 36.

The system is adapted for working with either a single or double battery. Where the number of lamps in the coach is large, or the stoppages of long duration, necessitating a battery of large capacity, a double battery is recommended; the size and weight of the individual cells are thereby reduced, and they can be more easily handled. Where the coach is required for intermittent service, or for a service of very varying character, a double battery is also recommended. With small coaches and where the service is regular, a single battery will be found advantageous on account of its smaller initial cost.

Excess current cannot be passed through the battery owing to the perfectly self-regulating properties of the machine, the output of which can be adjusted to suit the demands of any class of service.

PUMPS FOR FIRE DUTY ON SHIPS.

While the Board of Trade specifies in its regulations dealing with fire-fighting apparatus for ships, that a certain number of pumps of definite capacity must be installed on all vessels, the type of pump is left to the discretion of owners. It has been usual to install reciprocating steam pumps, but there seems no valid reason why the centrifugal pump should not be employed for fire duty. It is of light weight, it occupies but little floor space, and its output is large for its size, and it can be coupled direct to an electric motor.

The Board of Trade regulations call for a pump capable of delivering 250 gallons per minute against a pressure of 100 lbs. per square inch. In practice this means that each pump must be able to throw two jets to a height of 67 ft. or horizontally to a distance of 52 ft., each jet being supplied through 100 ft. of canvas hose fitted with a $\frac{7}{8}$ in. nozzle.

A two-chamber turbine pump of the pattern supplied by Mather & Platt, Ltd., Park Works, Manchester, when running at 1,400 r.p.m. will throw two jets horizontally about 60 ft., the water being supplied through 50 ft. of $2\frac{1}{2}$ in. canvas hose with $\frac{7}{8}$ in. nozzle. This absorbs about 23 h.p. and a motor of about 28 h.p. would be suitable for driving it. A motor-driven turbine pump of this type is here illustrated, both the pump and its motor being manufactured by Mather and Platt, Ltd. Current would normally be drawn

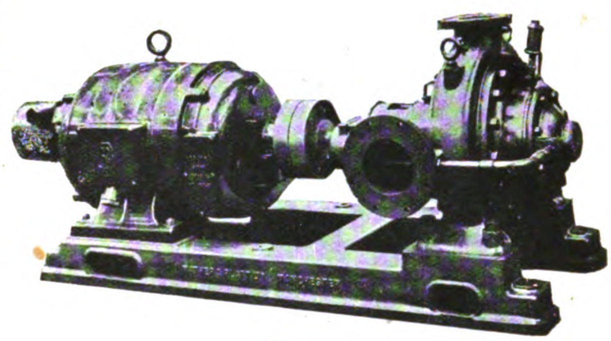
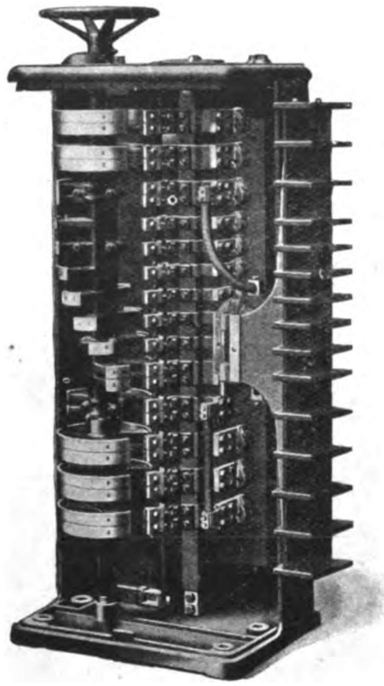


Fig. 37.

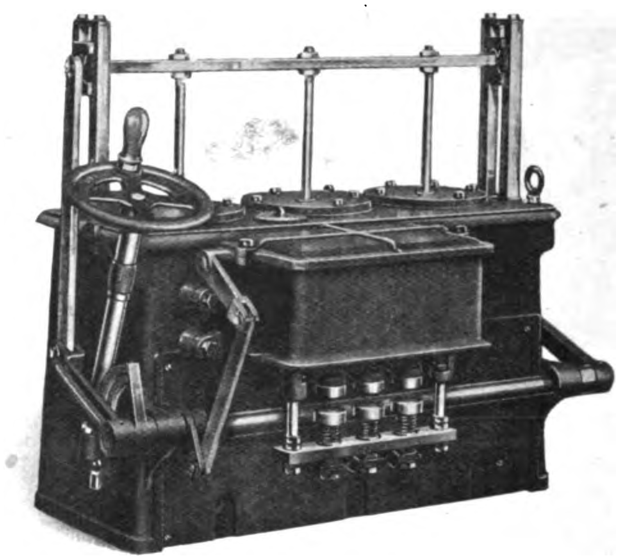
for the ship's lighting and power installation, but provision should be made for connection to the emergency set, which is now usually carried on deck to permit of some amount of lighting being maintained and a supply given for wireless purposes, in the event of the main sets being put out of gear. There must be no risk of a breakdown or failure of supply in connection with fire fighting, and a duplicate source of supply for motors driving fire pumps is most desirable.

Mather & Platt, Ltd., have just published a catalogue dealing with fire protection on board ships. It gives much useful information as to the number and type of appliances that must be carried on various classes of vessels in order to comply with the Merchant Shipping (Convention) Act, 1914, the provisions of which are about to come into operation.

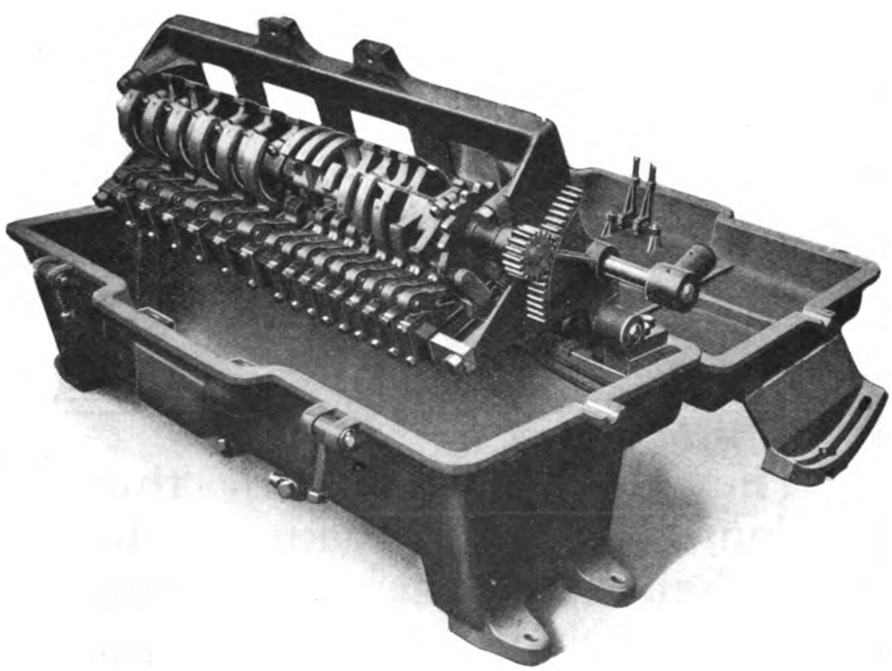
The Advertisements in this Journal are arranged in alphabetical order, according to the Name of the Firm.



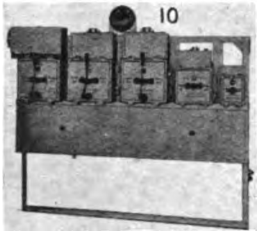
Large Size Crane Controller.

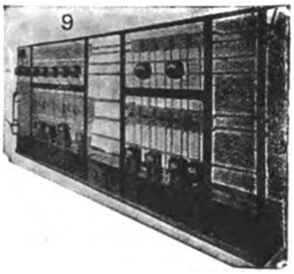


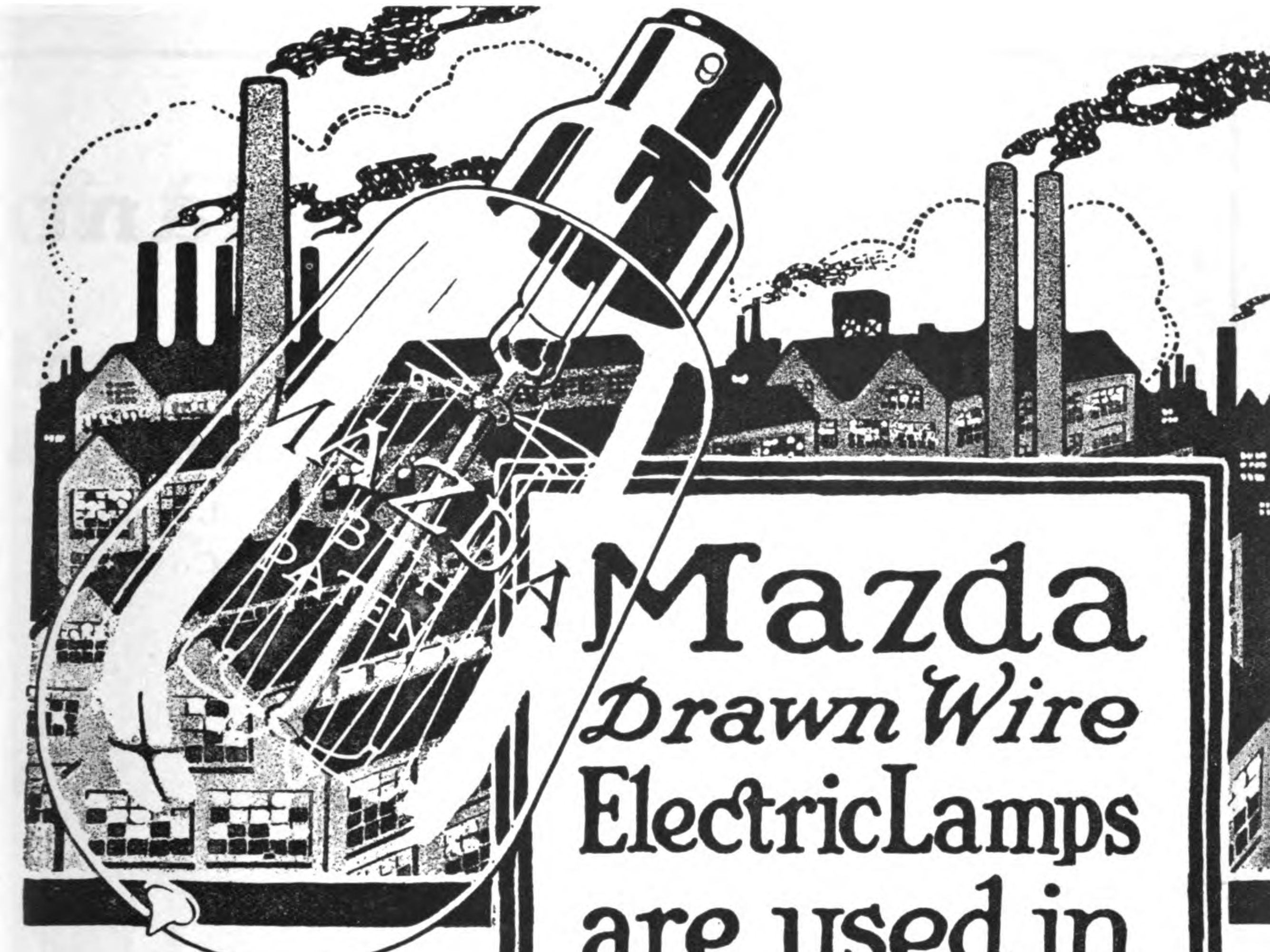
Mining Type Liquid Starter.



Oil-Immersed Reversing Controller.


10

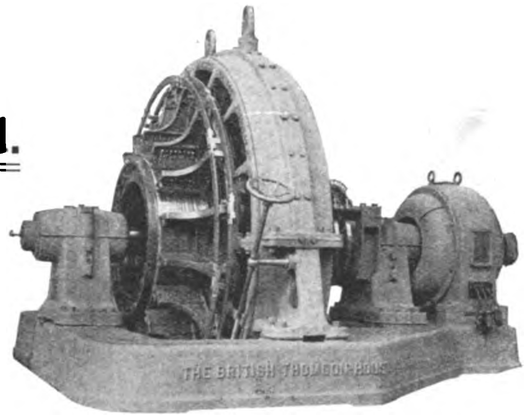

9



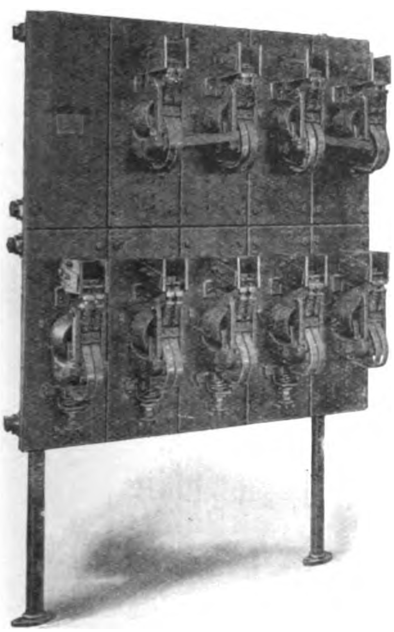
# of Quality

Houston Co., Ltd.

& Manufacturers



B.T.H. Rotary Converter.



B.T.H. Contactor Panel.

Tirrill Regulators
Electricity Meters
Air Compressors
Switchboard Instruments
Controllers and Resistances
Mazda Drawn Wire Lamps
B.T.H. Carbon Lamps

Automatic Control Gear **Lighting Appliances**

Sprague Thomson-Houston System of Multiple Unit Control

Foreign Representatives:

ARGENTINA.—Cia. General Electric Sudamericana Inc., Buenos Ayres.

AUSTRALIA.—Australian General Electric Co., Melbourne and Sydney; Unbehaun & Johnstone, Adelaide; Engineering Supply Co., Ltd., Brisbane; Chas. Atkins & Co., Ltd., Perth.

BRAZIL.—Cia. General Electric do Brazil, Rio de Janeiro.

CHILI.—The International Machinery Co., Santiago.

CHINA.—Andersen, Meyer & Co., Ltd., Shanghai.

COLOMBIA.—Wesselhoeft & Wisner, Barranquilla

INDIA.—The British Thomson-Houston Co., Ltd., Calcutta; Turner, Hoare & Co., Bombay.

JAPAN.—The British Thomson-Houston Co., Ltd., Yokohama; Bagnall & Hilles, Yokohama; Mitsui & Co., Tokyo and Osaka.

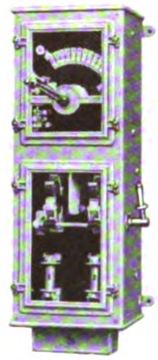
MEXICO.—Mexican General Electric Co., Mexico City.

NEW ZEALAND.—The National Electric and Engineering Co., Ltd., Auckland, Christchurch, Dunedin and Wellington.

SOUTH AFRICA.—The South African General Electric Co., Johannesburg and Capetown; Johnson & Fletcher, Bulawayo and Salisbury.

BROOKHIRST SWITCHGEAR

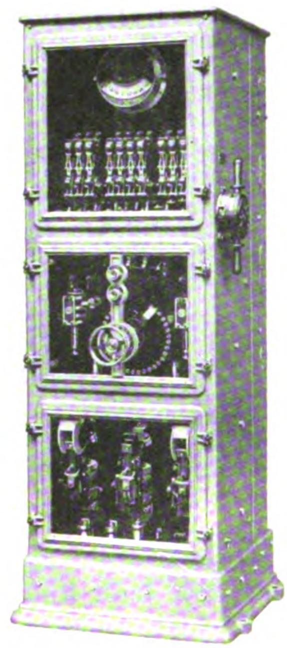
FOR CONTINUOUS CURRENT MOTORS



2 BW

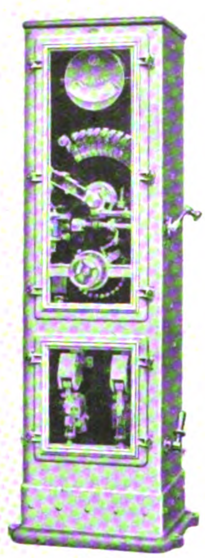
12 BW

CS 2



ML 13

BS 2



13 CP

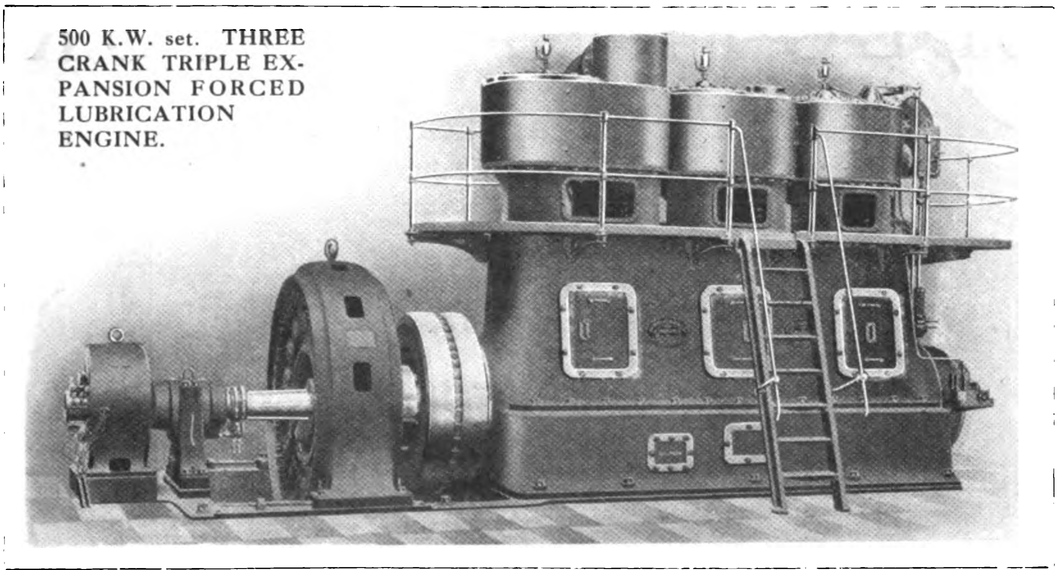
BROOK
HIRST
& C° L^{TD}

Northgate
Electrical Works
CHESTER

12 BP/R

Representative selection of BROOKHIRST Motor Controlling Switchgear

For Prices and Full Particulars see Catalogue No. 3



ARE YOU INTERESTED
IN VERTICAL STEAM OR GAS DRIVEN POWER PLANTS ?

BROWETT-LINDLEY engines are as simple as can be manufactured to give great economy combined with high efficiency.

¶ This result has only been obtained by careful design and the best possible workmanship.

¶ The advantages of these engines have long been recognised by Owners of Collieries, Ironworks and other Industrial undertakings for generating power with minimum amount of attention.

¶ They are particularly suitable where long non-stop runs are required, such as for Power Stations and Paper Mills, a great number being in operation under these conditions.

¶ Ask us to mail you our Pamphlets and Illustrated Catalogue.

Browett-Lindley

& CO., LTD.,

PATRICROFT, MANCHESTER

and

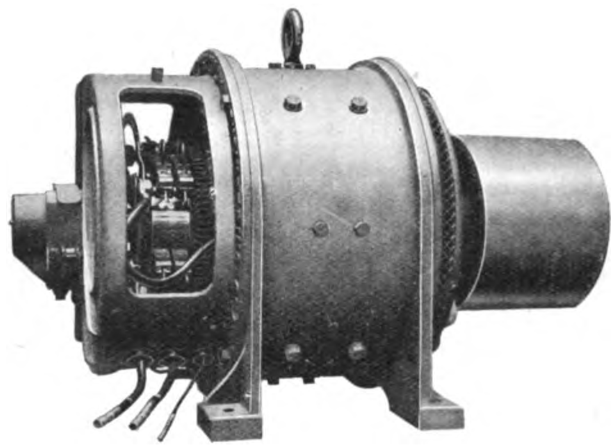
Amberley House, Norfolk Street, Strand, LONDON, W.C.

AGENTS—

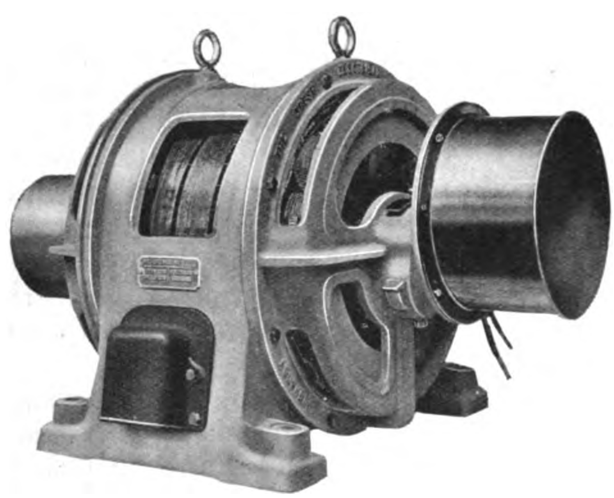
ARGENTINE REPUBLIC: Agar, Cross & Co., Ltd., Buenos Ayres.
CANADA; The John McDougall Caledonian Ironworks Co., Ltd., Montreal.
SOUTH AFRICA: Hubert Davies & Co., Johannesburg, Durban, etc.
SPAIN: Ricardo Zaragoza, Barcelona.
JAPAN: L. J. Healing & Co., Ltd., Yokohama and Kobe.
AUSTRALIA; Simpson Bros., Lawson House, 49, Clarence Street, Sydney.
NEW ZEALAND: J. Chambers & Son, Ltd, Auckland, Wellington.
NORWAY; Aktieselskabet Lorentzen & Wettre, Kristiania.
FINLAND: Aktiebolaget Ekstroms Maskinoffar Osakeyhtio, Helsingfors.

ELECTRIC MOTORS

For all applications.



Standard protected type DIRECT CURRENT Interpolar machine, with fan system of ventilation. Ring lubricated bearings.

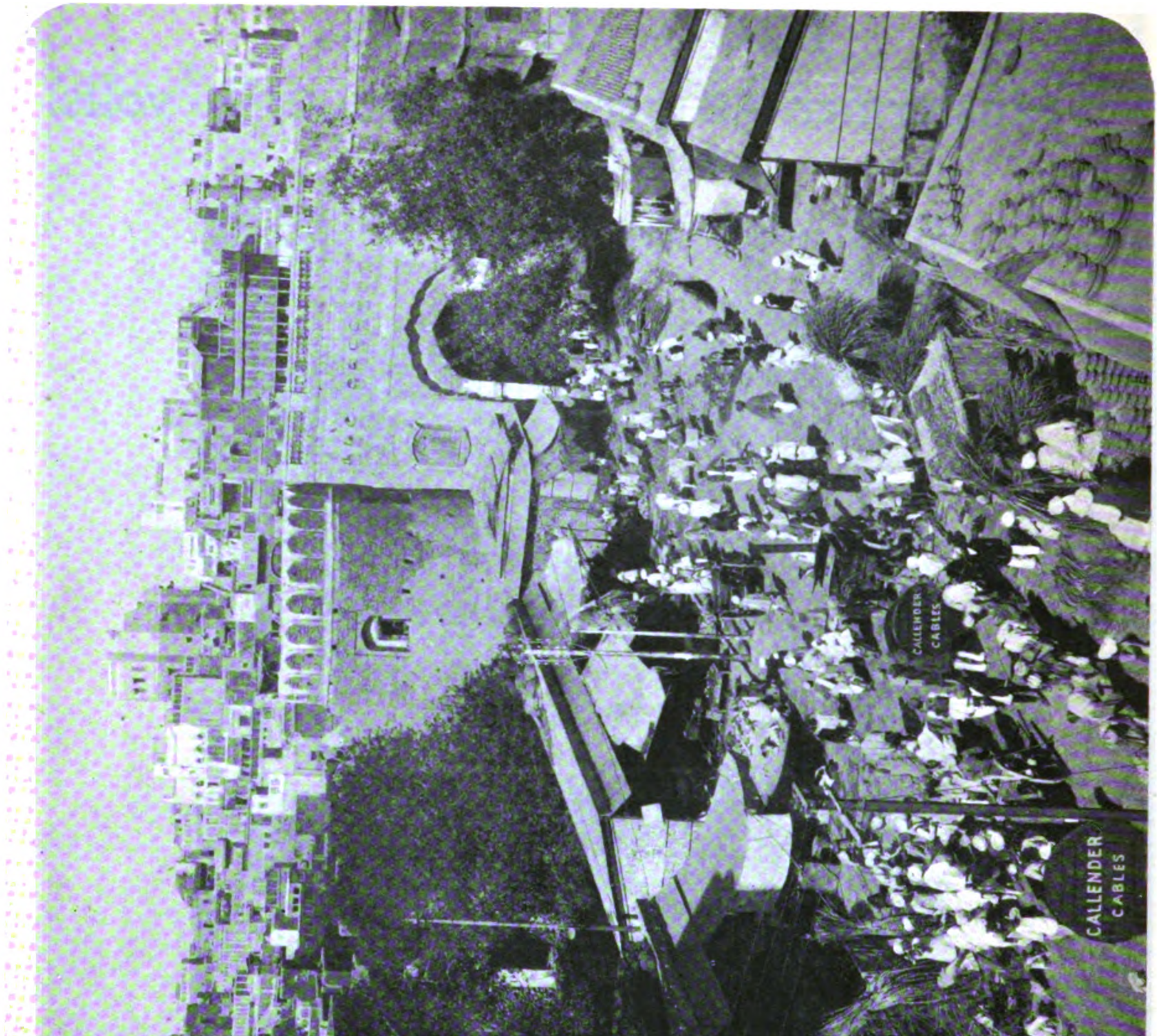


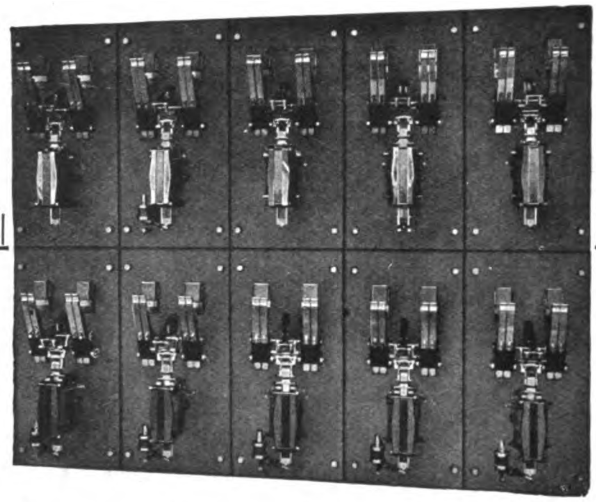
Standard protected type ALTERNATING CURRENT Induction Motor. Wound Rotor with enclosing cover for slip rings. Standard ring lubricated bearings and terminal cover for starter leads.

For Advice, Prices and Particulars, apply to

The Brush Electrical Engineering Co., Ltd.

Falcon Works: - - Loughborough.
London Office: No. 1, Kingsway, W.C.

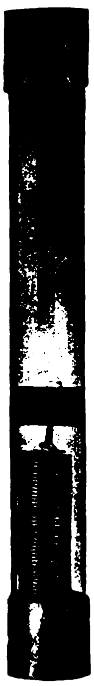

CALLENDER CABLES
CALLENDER CABLES



900 H.P., 440 volts, 40 cycles 3-phase operating Hydraulic Accumulator Set.

SAVE LABOUR.

INCREASE OUTPUT.



EMPIRE S. & C. HIGH-TENSION FUSE (Blown).
For 66,000 volts to 110,000 volts.

"EMPIRE" AUTOMATIC CONTROLLERS

MADE BY

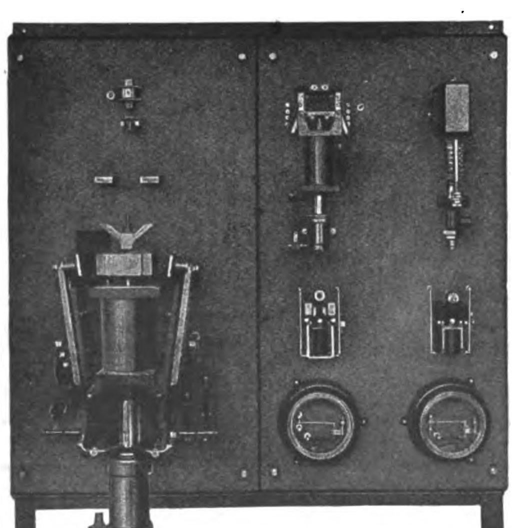
ELECTRIC CONTROL LIMITED, GLASGOW.

BRANCH OFFICES—
London. Newcastle. Belfast.
Manchester. Cardiff. Birmingham.

FOREIGN OFFICES—
Moscow. Turin.

EMPIRE S. & C. HIGH-TENSION FUSE.
For 1 to 100 amps.

200 H.P. Air Compressor Controller, with Shunt Regulator, and Unloading Device.

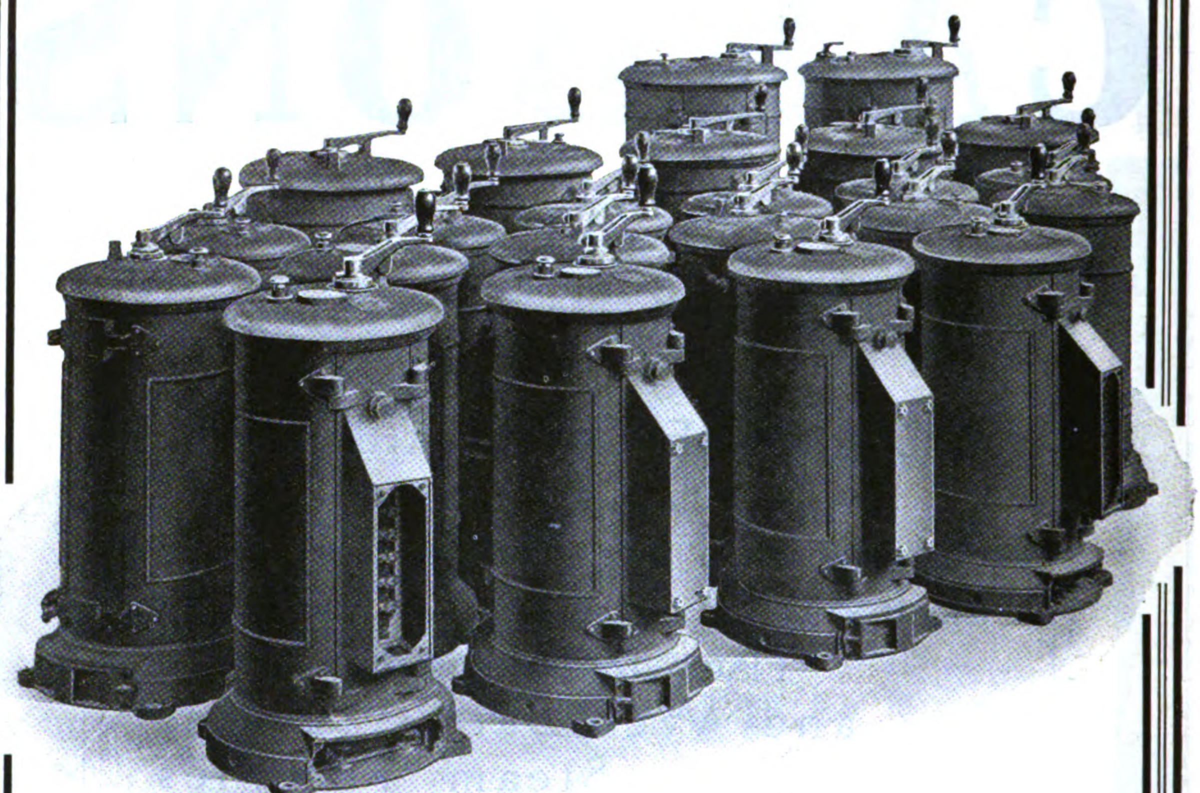


Write for Fuse Booklet.

Send us your Enquiries for Controllers.

VICKERS CONTROL PILLARS

For controlling motors driving all classes of machinery subjected to frequent starting and stopping operations.



THE ELECTRIC & ORDNANCE ACCESSORIES

COMPANY LIMITED.

WARD END WORKS, BIRMINGHAM.

Telephone : 960 East.

Telegrams : "Vickers, Birmingham."

AGENTS :

LONDON : Electrical Department, Vickers House, Broadway, Westminster, S.W.

MANCHESTER : R. Foster, 196, Deansgate.

GLASGOW : J. & A. Anderson, 231, St. Vincent Street.

SHEFFIELD : H. E. Ridley, 19, Vainor Road.

AGENTS :

NOTTINGHAM : F. Mansfield, 197, Station Road, Beeston, Notts.

SWANSEA : W. Ogden Dayson, 1, Mount Street.

YORKSHIRE & THE TEES : F. MacCallum, Austhorpe Road, Crossgates, Leeds.

MIDLANDS : Bill & Berry, 39, Great Charles Street, Birmingham.

NEWCASTLE-ON-TYNE : T. J. Grainger & Co., Edinburgh Life Buildings, 21, Mosley Street.

NEW ZEALAND. Jas. J. Niven & Co., Ltd., Wellington.

CALCUTTA. Heatly & Gresham, Ltd., Waterloo St.
BOMBAY, Heatly & Gresham, Ltd., Hornby Road

MOTORS AND DYNAMOS

Continuous Current
1 to 100 H.P.

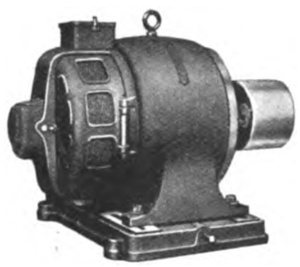
Open protected.

British built throughout.

Sound in construction ensuring freedom from breakdown.

Represent the latest practice because we make nothing else.

High efficiency and free from commutation troubles.



Enclosed Ventilated.

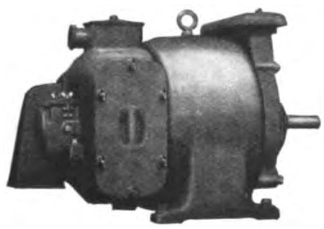
Competitive in price, rating for rating.

Stocks available in Australia, India, and New Zealand.

"Magnet." Manchester
"A.B C., 5th Edition."

Electromotors Limited

OPENSHAW:
Manchester, England.



Pipe Ventilated.

RUSSIA. A. V. Frank, Dobra Slobodka No. 12, Moscow.

TRANSVAAL & RHODESIA. Reath & Co., Johannesburg.

NATAL. A. B. Jones, Ltd., Durban.
ARGENTINE. Angel, Muzzio é Hijos, Rosario

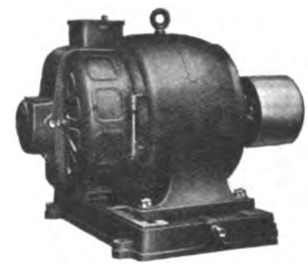
VICTORIA, TASMANIA & SOUTH AUSTRALIA. Horrocks, Roxburgh Pty, Ltd., Melbourne.

NEW SOUTH WALES & QUEENSLAND. T. K. Steanes, Pitt Street, Sydney.

MOTEURS ET DYNAMOS

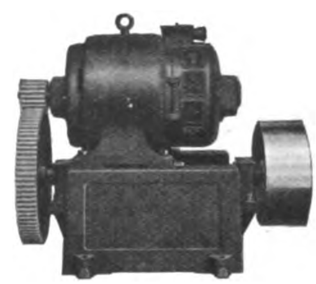
à courant continu,

de la force de 1 à 100 chevaux.



Totally Enclosed.

Fabrication entièrement anglaise. Construction très robuste garantissant contre tout danger de panne. Ces machines constituant notre seule spécialité, elles incarnent les derniers perfectionnements. Rendement élevé et absence d'hypercommutation ou hypocommutation nuisibles. Défient toute concurrence de prix à capacité égale. Stocks prêts pour la livraison en Australie, aux Indes et en Nouvelle Zélande.

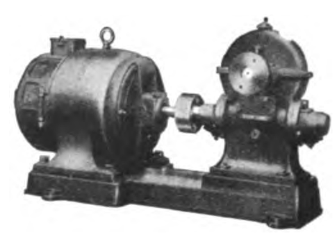


With Reduction Gear.

"Magnet." Manchester.
"A. B. C., 5th Edition."

Electromotors Limited

OPENSHAW:
Manchester, England.

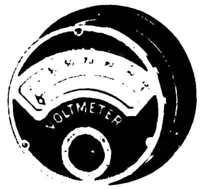


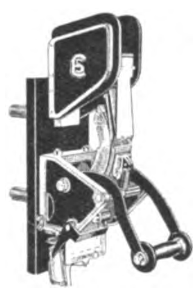
With Worm Gear.

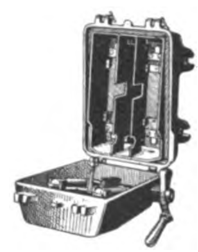
ITALY. Carrera & Milanesi, Corso Venezia, Milano.

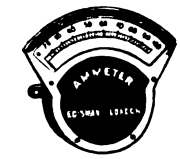
OLLAND. G. W. E. Gibson, 55 Stadhoudersplein, The Hague.

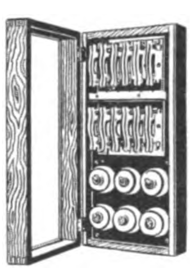
GREECE. J. McD. Barbour, Vulcan Works, Piræus.
MADEIRA. Raleigh C. Payne, Caixa, No. 17.

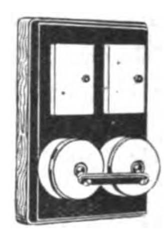

VOLTMETER

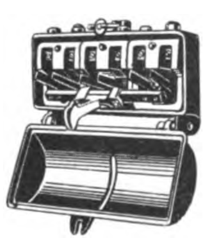


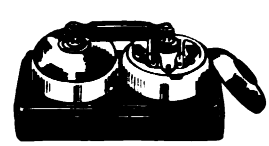


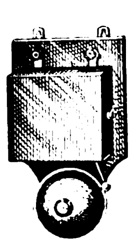

AMMETER

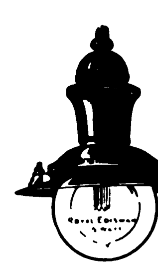








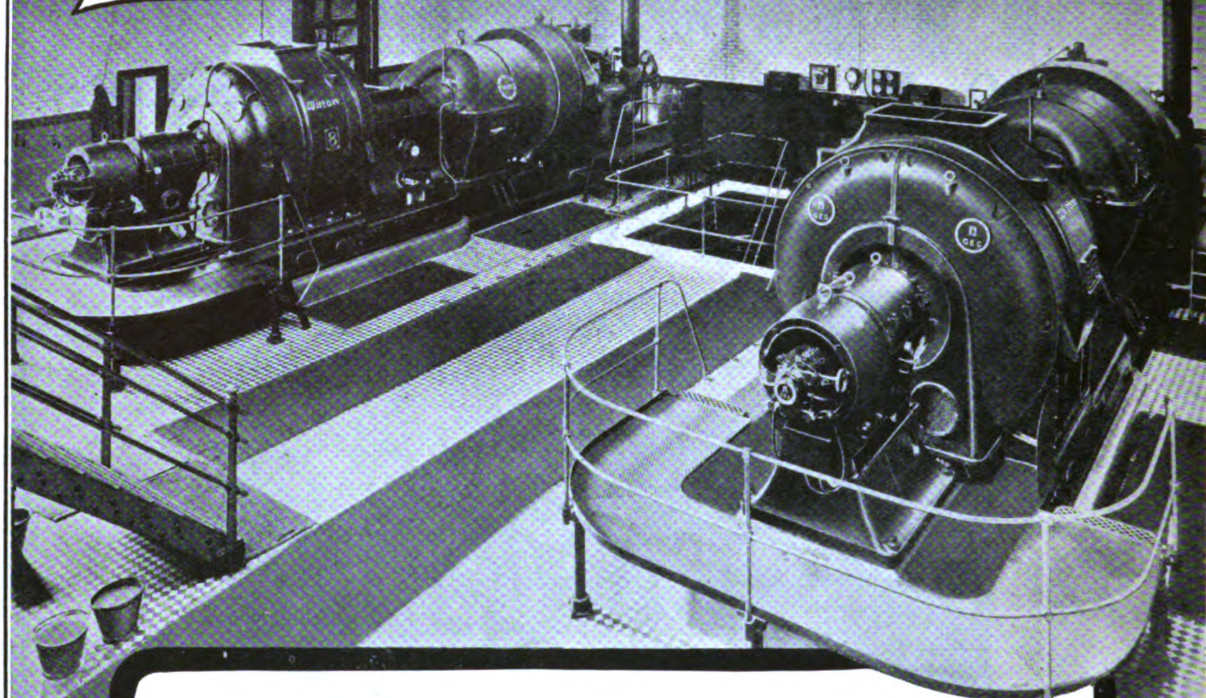




THE EXPORT TRADE AND THE NAVY

Are two inter-dependent elements of Great Britain's resources on which She and our Allies rely.
The Navy has to be paid for by the Commerce of the country; the Overseas Trade has to be protected by the Navy.
Financial resources are the product of thought and labour.
Imports must be paid for by the exportation of either manufactured Products or reserves of Capital. When reserves are exhausted borrowing is the only alternative.
It is clear that *the credit of Great Britain rests on her manufacturing and exporting capacities.*
Buyers everywhere sympathetic to Great Britain will appreciate these facts; they can help the cause of the Allies by placing their orders with British Manufacturers, even though in some cases delivery is unavoidably delayed.

G.E.C. Electrical Plant



"WITTON" Turbo-Generators are designed on sound principles and have behind them our large experience in the construction of generators and other electrical plant for every purpose. Long and efficient service is ensured by mechanical simplicity, solidity and thoroughness of construction. All plant is subject to exacting test before leaving the Witton Works. The illustration shows a set of Turbo-Generators installed by the G.E.C. at a London power house. Write for illustrated bulletins of "Important Plant" to

The General Electric Co., Ltd.

Head Office: **67, Queen Victoria St., London, E.C.**

Cablegrams: "Polyphase, London." *Telegrams: "Electricity, Cent., London."*
Telephone: London Wall No. 3600 (30 lines).

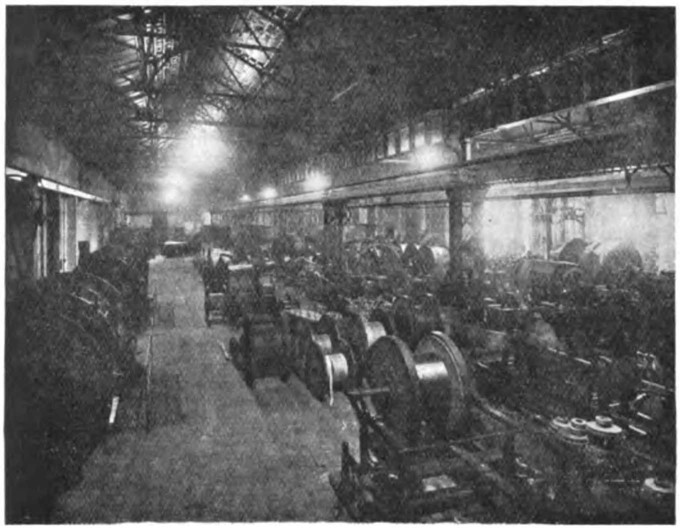
Home Branches:—Manchester, Liverpool, Leeds, Sheffield, Glasgow, Aberdeen, Birmingham, Nottingham, Belfast, Dublin, Cork, Cardiff, Bristol, Swansea, Newcastle-on-Tyne, Hull, Southampton.

Works. Witton, Manchester, Birmingham and London.

Regd. Trade Mark

THERE is no reason that we can even imagine why we should not collaborate with our Allies in peace as well as in war. But neither in peace nor in war shall we retain the foremost place in the world by the assistance of our Allies. That must be done by our own exertions and, above all, by our own superior intelligence, and to secure for ourselves superior intelligence we must be superior in chemistry and in all the natural sciences.

—*The Statist.*



View in one of our Cable Shops at Charlton.
(Night photo, showing Metroflam Lighting).

CABLES

For Working Pressures up to 30,000 VOLTS.

V.I.R. Cables, Wires and Flexibles, Association and Non-Association Classes.

Paper-Insulated Lead-covered and Armoured Cables.

Vulcanised Bitumen Cables, to Mining Rules.

Telephone Cables—Dry Core, Armoured and Non-Armoured.

Trailing Cables—Cab Tyre Sheathed and Hard Cord Braided.

Aerial Cables, Fire and Acid Resisting Cables, Signal and Shot-firing Cables, Bell Wires, etc., etc.

CONTRACTORS FOR COMPLETE LIGHTING AND POWER SCHEMES, UNDERGROUND AND OVERHEAD TRANSMISSION LINES, ETC.

DYNAMOS AND MOTORS

SWITCHGEAR for all purposes

TRANSFORMERS

INSTRUMENTS

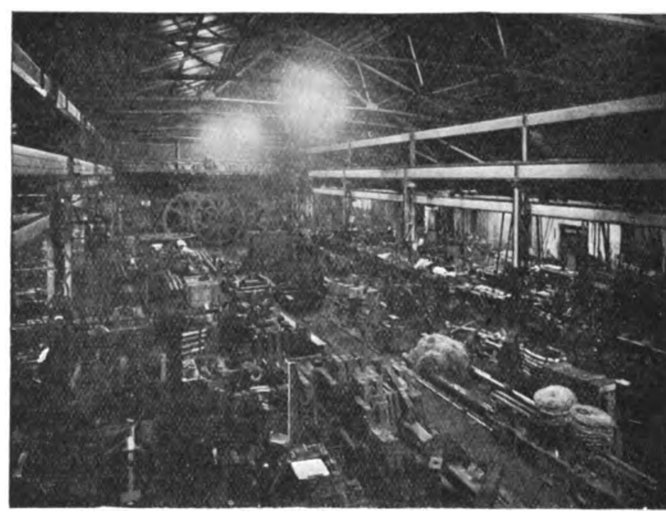
ARC LAMPS. The "Metroflam" long burning Flame Lamp is the cheapest high-power light.

SEARCHLIGHTS

INCANDESCENT LAMPS AND FITTINGS

LINE MATERIAL & INSULATORS

EVERY ELECTRICAL REQUISITE



View in one of our Engineering Shops at Charlton
(Night photo, showing Metroflam Lighting).

Established 1875.

JOHNSON AND PHILLIPS LTD CHARLTON, LONDON, S.E.

Cablegrams: "Juno, London."

CONTRACTORS TO BRITISH AND COLONIAL GOVERNMENTS.

Branch Offices and Stores:

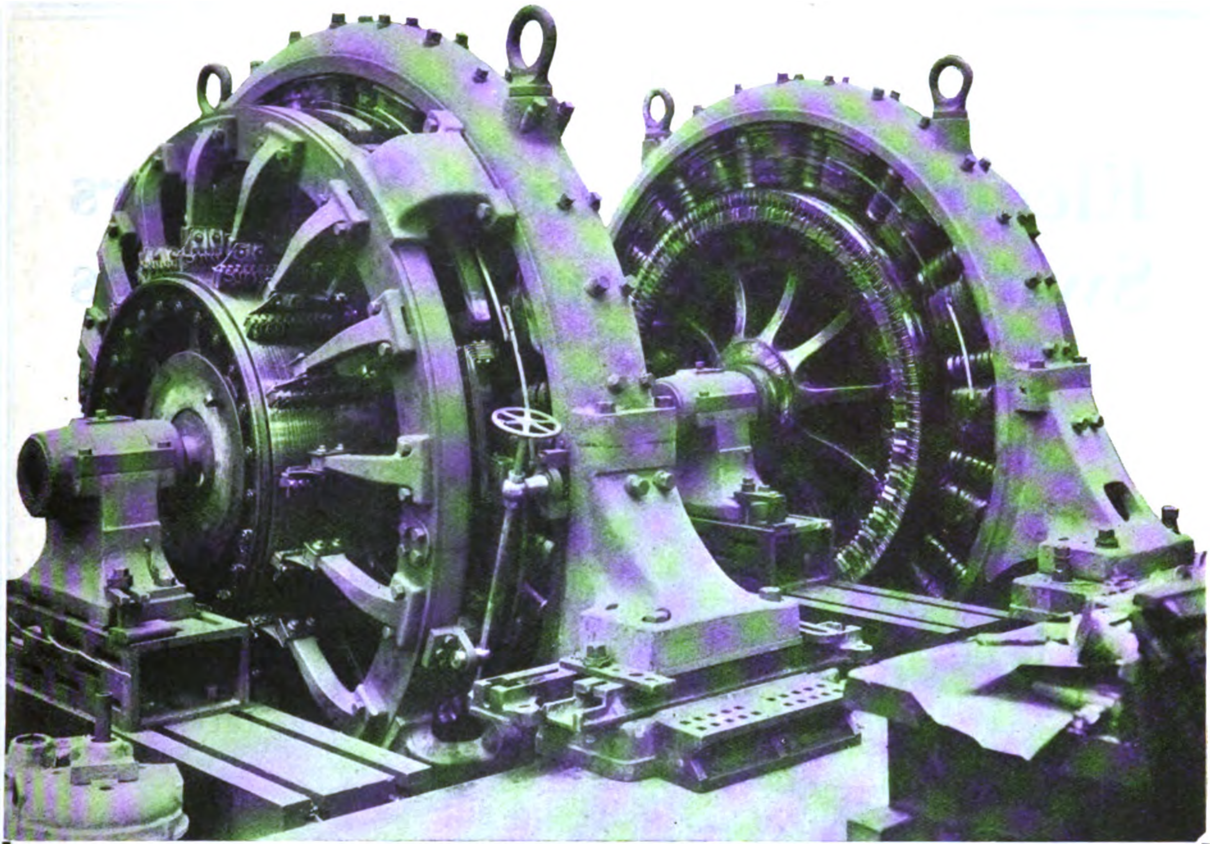
206, Corporation Street, Birmingham.
9, Park Place, Cardiff.
159, West George Street, Glasgow.
251, Deansgate, Manchester.
44b, Blackett Street, Newcastle-on-Tyne.

Agents:—

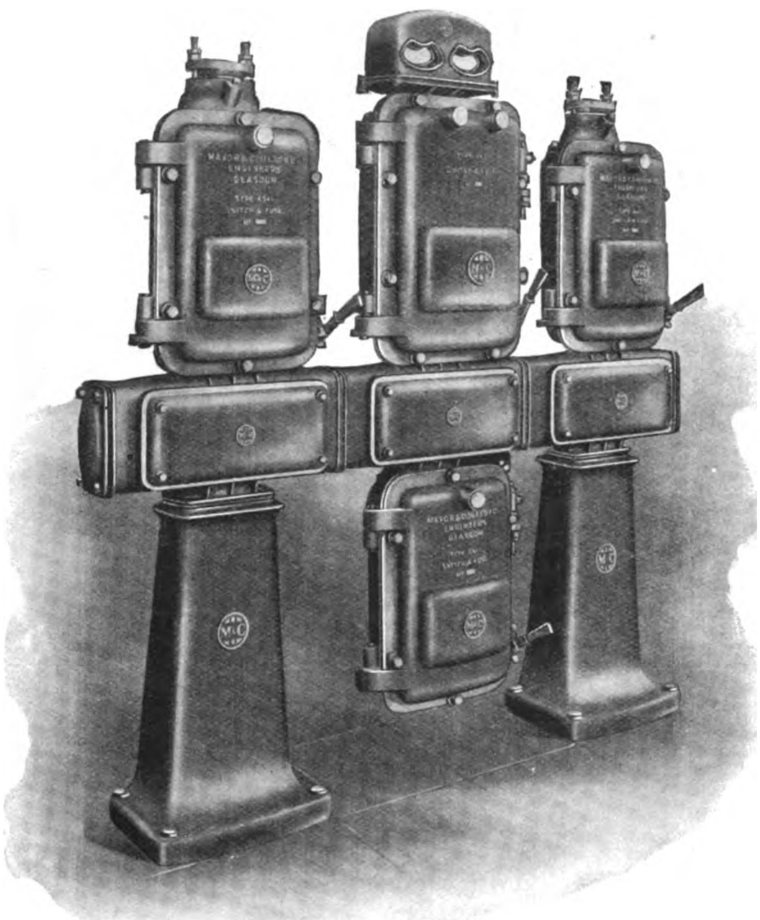
SOUTH AFRICA. R. H. Gould & Co., Basement, Trust Buildings, Johannesburg.
NEW SOUTH WALES.—N. Guthridge, Ltd., Equitable Buildings, George Street, Sydney.
NEW ZEALAND.—Tolley & Sons, Ltd., Chews Lane, Wellington.
INDIA.—Turner, Hoare & Co., Electrical Engineers, Bombay. Balmer, Lawrie & Co., Electrical Engineers, Calcutta.

THERE is a third stage in the history of the British Empire yet to be accomplished which will tax the highest statesmanship both here and in the Oversea Dominions. That third stage is the bringing together with a yet closer intimacy and union, organically as well as sentimentally and patriotically, of these great communities which by their wisdom have seen that they must each work out their own salvation themselves, and have yet seen that that salvation, that self-realization, can only be adequately pursued if they remember, not merely that they are of common descent, not merely that they inherit institutions worked out for them by the slow growth of ages in these islands, but also that in the fullness of time the true and proper climax of this great and historical evolution is not separate communities, however great, however free, scattered over the world, but one united Empire, in which the separate parts will never feel that they are hampered by belonging to a whole, but will fully realize that it is only by belonging to the whole that they can make the best of themselves.

The Hon. A. J. BALFOUR, *March 20, 1916.*



Electric Generators & Motors Switch-Gear and Accessories



UNIT TYPE MINING DISTRIBUTION BOARD.

Contractors to British Admiralty, War Office and other Government Departments.

Manufacturers of Alternating and Continuous Current Motors for all kinds of industrial work.

MAVOR & COULSON, LTD.

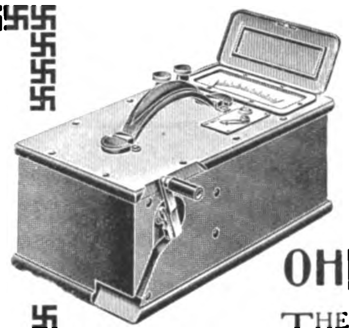
47, BROAD STREET, MILE END, GLASGOW.

Telegraphic Address: "Prodigious, Glasgow." **Telegraphic Codes: A.B.C. 5th Edition. Engineering, 2nd Edition. Bentley.**

Sturdy and Strong

Yet light in weight and above all accurate in construction. Every part of every N.C.S. Instrument is well and truly made—made to do true and permanent duty. Our thirty-one years' experience in the manufacture of N.C.S. Instruments means to *you* the highest value in, and the utmost service from, every instrument that you buy of us.

Our Catalogue—a work of reference on Electrical Measuring and Recording Instruments—will be sent you free, and with pleasure, on request.



OHMER **INSULATION TESTING SET**

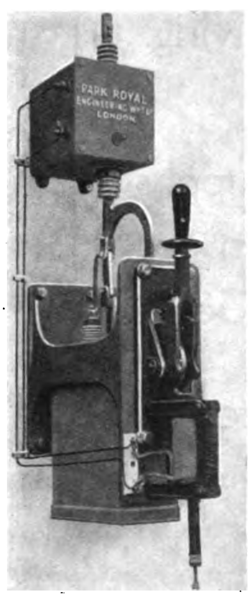
THE lightest, best and cheapest instrument of its kind on the market. It possesses many distinct advantages over any other Ohmmeter, either separate from or combined with a generator. It reads directly in megohms, and is independent of the voltage or speed of the generator.

COMMERCIAL INSTRUMENTS & INSTRUMENTS OF PRECISION.
AMMEIERS AND VOLTMETERS,
ROUND, SECTOR AND EDGEWISE.
WATERTIGHT AMPERE GAUGES.

NALDER BROS. & THOMPSON, Ltd.,

Head Office and Works - 97a, Dalston Lane, London, N.E.

Telegraphic Address: "Occlude, Kinlard, London."
Agents: Sydney, Calcutta, Bombay, New Zealand.
Agents required in other Countries.



Park Royal Engineering Works Ltd

PARK ROYAL, LONDON, W. **'Phones: Willesden {2223 2224**

¶ Oil switches and transformers embodying perfect design and the finest workmanship are constructed in our new factories and have taken their place among the most reliable and efficient of **MODERN SWITCHGEAR**

TARIFFS are founded on the conception of nationality; free trade on the ideal of international amity and a world-civilization. On examination these conceptions are seen to be complementary. An international alliance of weak and unwilling states would be useless for progress; only a voluntary co-operation of strong nations will produce a world-civilization worth having. Therefore, the first thing to do is to increase national strength—not only in a military sense, but in the arts, sciences and industries of peace, and in the understanding of the purposes of evolution. Every nation has a right to live, if it respect the same right for others. But the object and motive of Germany's high protective tariffs were far other than this. These walls were erected to build up the German Empire ***in order to use its power for conquest.*** Nevertheless, the same weapon may be used with fundamentally different motives, even as our purpose in military execution is diametrically opposite to Germany's original aim.

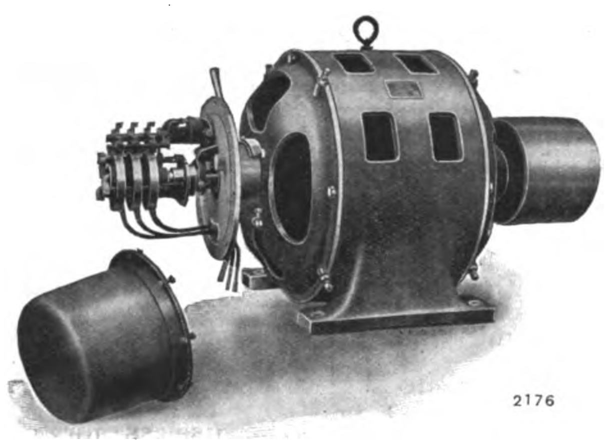
PEEBLES

TELEGRAMS:
"Peebles, Edinbnrgh."

Manufacturers of All Classes of Electrical Machinery

for Continuous and Alternating Currents.

We shall be glad to quote to your requirements on hearing from you.



Peebles Standard Slip-Ring Induction Motor.

Moteur "Peebles" asynchrone, type normal, avec induit à bagues collectrices.

AGENCIES.

AUSTRALIA. (Other than Western.) N. Guthridge, Ltd., Equitable Building, George St., SYDNEY. (Also at Melbourne.)

AUSTRALIA. (Western.) Denny Brothers, Limited, St. George's House, St George's Terrace, PERTH.

NEW ZEALAND. (North Island.) Grey Thorne George, Grey Buildings, High Street, AUCKLAND.

NEW ZEALAND. (South Island.) Scott Brothers, Ltd., Manchester Street, CHRISTCHURCH.

JAPAN. L. J. Healing & Co., Ltd., 22, Yamashita-cho, YOKOHAMA. (Also at Kobe, Tokyo and Osaka.)

BRAZIL. S. McLauchlan & Cia. Caixa do Correio, 455, RIO DE JANEIRO.

Alternators, Dynamos, Motors, Rotary-Converters, Motor-Converters, &c., &c.

BRUCE PEEBLES

ENGINEERS,
INGENIEURS CONSTRUCTEURS.

EDI

THE CLASSIFIED DIRECTORY OF MANUFACTURES

in this Journal is a most valuable assistance to buyers. The classifications have been made with care to facilitate reference, and the cross indices in French, Spanish and Russian enable the purchaser familiar with these languages to find readily the article he is seeking under the English name. Readers should consult this Directory and write direct to members, whose names and full addresses are given at the end.

REES ROTURBO

PATENT PRESSURE CHAMBER CENTRIFUGAL

REES "RoTURBo" TRADE MARK

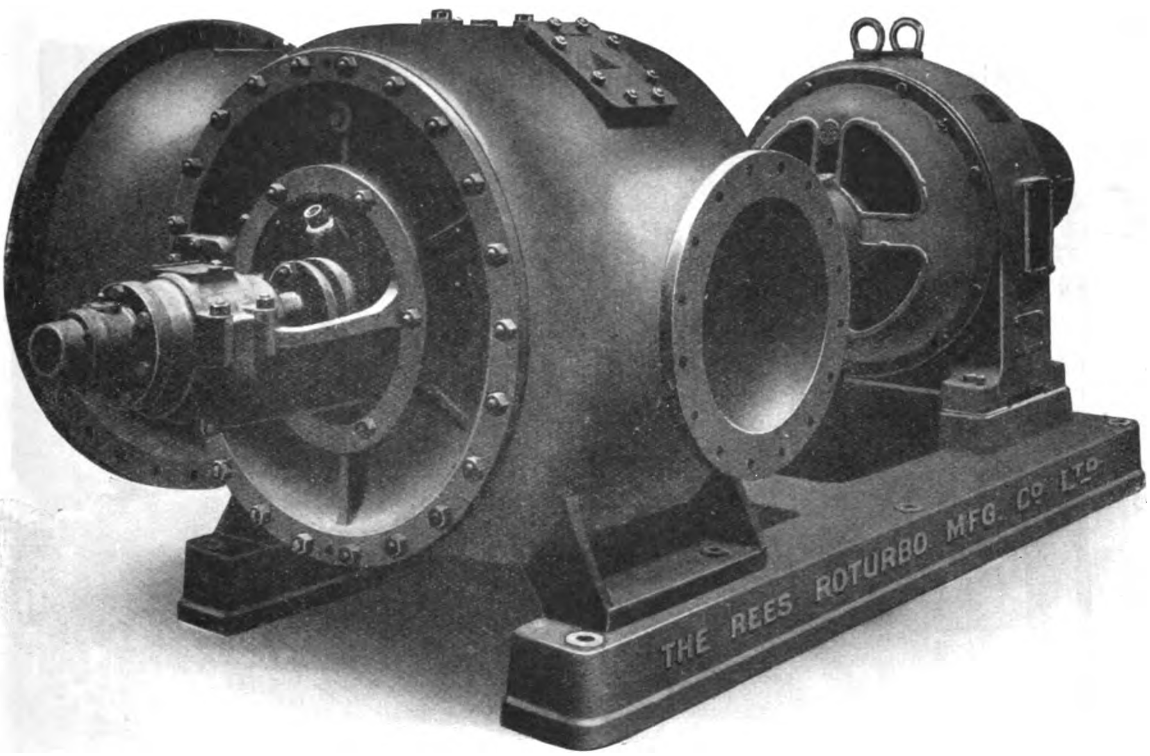
PUMPS

REES "RoTURBo" TRADE MARK

FOR ALL PURPOSES.

INCLUDING AUXILIARIES FOR

CENTRAL POWER STATIONS



Motor-Driven Rees Roturbo Pressure Chambor Extraction Pump.
For 6,000 K.W. Jet Condenser.

The REES ROTURBO Mfg. Co., Ltd.

HYDRAULIO, ELEOTRICAL AND QENERAL ENGINEERS,

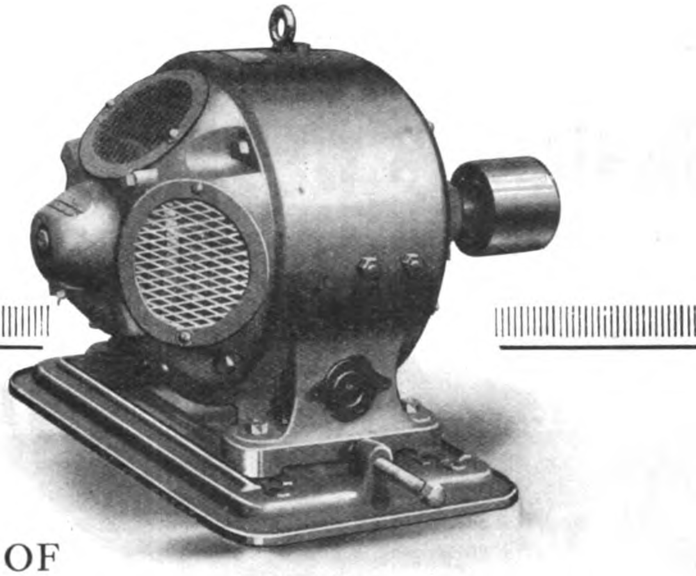
WOLVERHAMPTON, ENGLAND.

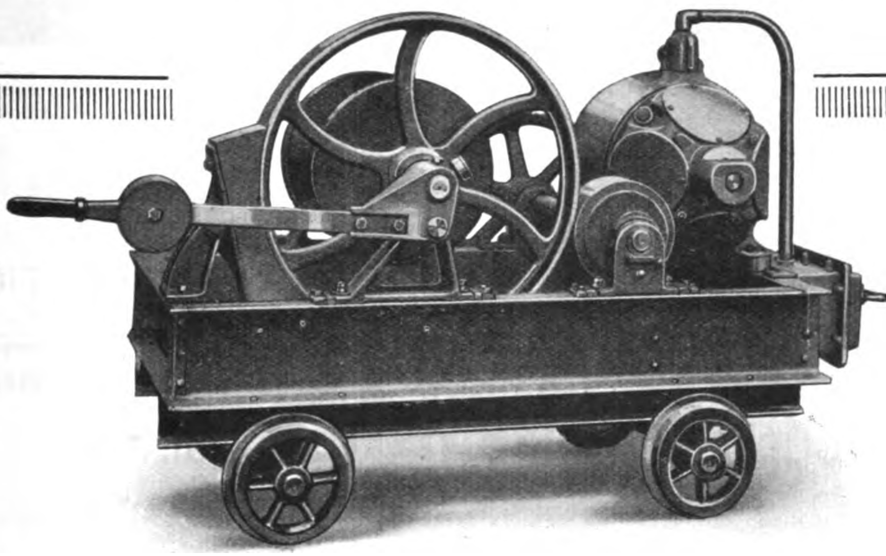
TELEGRAMS—
HYDROTURBO, WOLVERHAMPTON.
HYDROTURBO, ESTRAND, LONDON
(Inland only).

ON ADMIRALTY, WAR, INDIA, HOME
AND COLONIAL OFFICE LISTS.

TELEPHONES—
No. 900 Wolverhampton.
No. 1511 Central, London.

LONDON OFFICE: HASTINGS HOUSE, NORFOLK STREET, STRAND, W.C.

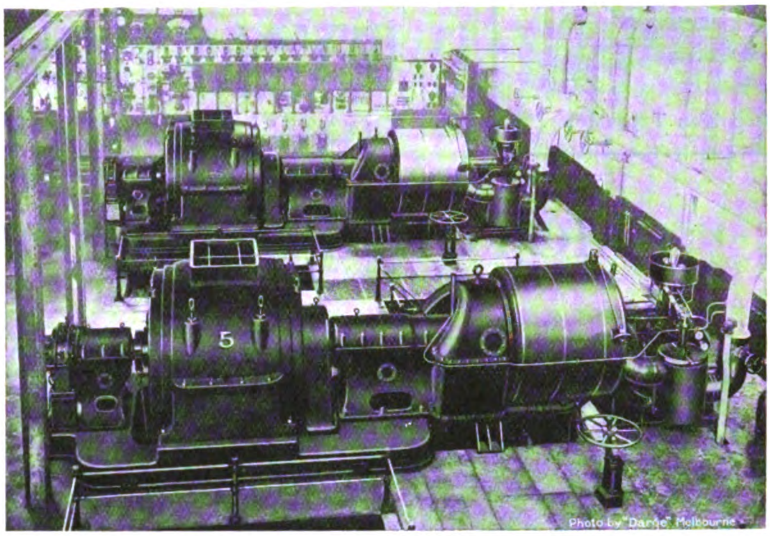




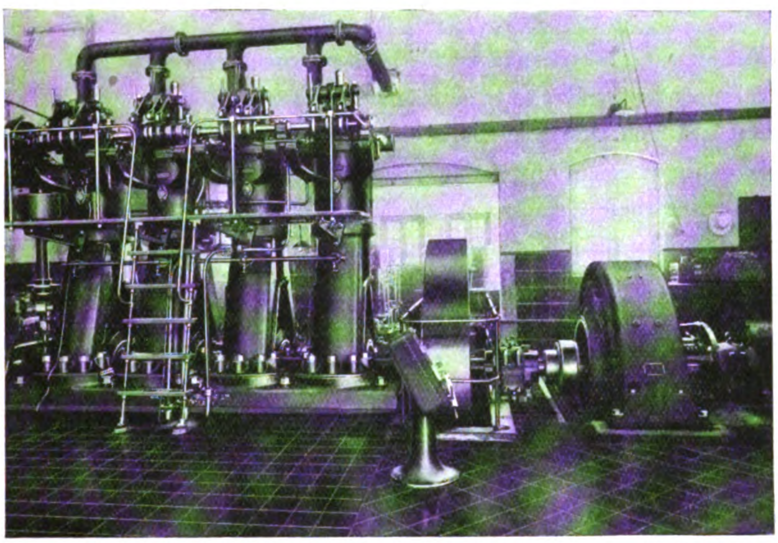
READERS of these pages will find a condensed and ready reference to all classes of Electrical and Steam Machinery and Accessories in THE CLASSIFIED DIRECTORY OF MANUFACTURES, at the back of this Journal. The names and addresses of the firms are given in the Index at the end. Write direct to the firms for prices and further information.

Steam Turbines.

Illustration shows
TWO WILLANS STEAM TURBINES
coupled to
THREE-PHASE ALTERNATORS
4000 K.W.
1500 R.P.M.
installed at The Melbourne Corporation Electric Light Station.



Diesel Engines.



Simplicity in design and high quality of materials and workmanship.

NINE YEARS' ACTUAL MANUFACTURING EXPERIENCE REPRESENTING OVER 27,000 H.P.

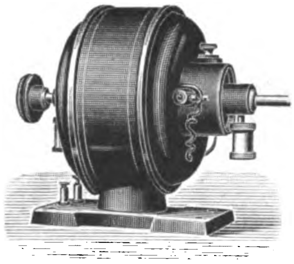
Illustration shows a 225 B.H.P. Willans Diesel Engine installed at Mandalay.

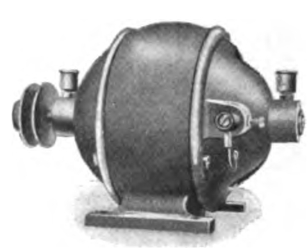
Willans & Robinson, Ltd.

Victoria Works, Rugby.

Foreign Branches and Representatives:

AUSTRALIA.—Willans & Robinson, Ltd., G.P.O. Box, 447, Sydney, N.S.W.
ARGENTINE.—J. F. Macadam & Co., 302, Balcarce, 326, Buenos Aires.
CANADA.—Willans & Robinson, Ltd., 213, Kerr Block, Regina; W. A. Martin & Co., 70, Lombard Street, Toronto; Rudel Belnap Machinery Co., Canadian Express Building, Montreal.
CHILI.—Mitrovich Hermanos, Iquique.
EGYPT.—Sayer & Colley, 31, Savoy Chambers, Cairo.
MALAYSIA.—Central Malay Motor & Eng. Works, Kuala Lampur, Selangor.
RUSSIA.—Hugh Ledward, P.O. Box 455, Moscow.


Repulsion Type Motor.


Direct Current Motor.

DYNAMOS

AND

MOTORS FOR ALL TRADES

Special Motors for MEDICAL and SCIENTIFIC APPARATUS, MACHINE TOOLS, etc.

We can supply a motor for every purpose from $\frac{1}{30}$ horse power to 100 horse power.

Also "ECONOMIC" GRINDING ATTACHMENTS for BENCH AND MACHINE.

The "Economic" Electric Tool Grinders have been produced to meet the demand for really efficient and powerful machines capable of withstanding the roughest treatment at the hands of inexperienced workmen, without demanding constant attention or the frequent renewal of parts. Our aim has been to make these Grinding Machines as "fool-proof" as possible, and we have rigidly excluded from our designs all unpractical devices which reduce electrical efficiency and introduce elements of unreliability.

Contractors to Admiralty, War Office, Post Office, Colonial and Foreign Governments, Corporations, Railway and Shipbuilding Companies, etc.

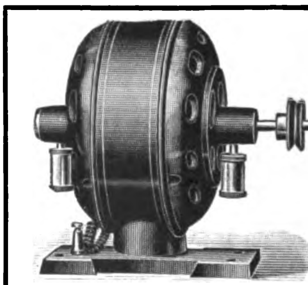
WILSON - WOLF

ENGINEERING COMPANY LTD.


Direct Current Motor.

BRADFORD

TELEGRAMS - - - "ENERGY, BRADFORD."
CODES - - A.B.C. 5th EDITION AND PRIVATE.
TELEPHONE - - - - 1753 BRADFORD.


Induction Type Motor.

CLASSIFIED DIRECTORY OF MANUFACTURES

MANUFACTURES OF MEMBERS. PRODUCTIONS DES ASSOCIES. PRODUCCIONES DE LOS SOCIOS
ПРОИЗВОДСТВА УЧАСТВУЮЩИХЪ ФИРМЪ.

ACCESSORIES for Power, Lighting, Bells and Signalling.

ACCESSOIRES pour Force Motrice, Eclairage, Sonneries et Signaux.

ACCESORIOS para Fuerza Motriz, Alumbrado, Campanillas y Señales.

ПРИНАДЛЕЖНОСТИ для Двигателей, Освѣщенія, Звонковъ и Сигналовъ.

Bells (for bell wires, see under " Wires ").

Sonneries (pour fils de sonneries, voir " Fils ").

Campanillas (para alambres de campanillas, véase " Alambres ").

Звонки (звонк. провода, см. ,,Провода").

BERRY, SKINNER & CO
BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD
SANDYCROFT LTD.
SIEMENS BROS. & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Casing and Capping.

Moulures pour Fils.
Cajetines para Alambres.
Ройки для Проводовъ.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Roses.

Rosaces de Plafond.
Rosetones de Techo.
Потолочныя Розетки.

BERRY, SKINNER & CO
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Cut-outs.

Coupe-Circuits.
Cortacircuitos.
Предохранители.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD
ECKSTEIN, HEAP & CO, LTD
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO. LTD.
GENERAL ELECTRIC CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
IGRANIC ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Indicators.

Indicateurs.
Indicadores.
Индикаторы

BERRY, SKINNER & CO
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
NALDER BROS. & THOMPSON, LTD.
REASON MANUFACTURING CO. LTD.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Lampholders.

Douilles.
Portalámparas.
Патроны.

BERRY, SKINNER & CO.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Plugs and Sockets.

Fiches et Prises de Courant.
Llaves y Cajas de Contacto.
Контачныя Штепселя и Коробки.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Pushes.

Boutons de Poussoirs.

Botones de Llamada.

Звонковыя Кнопки.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD
IGRANIC ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO., LTD

Tumbler Switches.

Interrupteurs à Boule.

Llaves de Concha.

Выключатели съ опрок. головкой.

BERRY, SKINNER & CO.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO. LTD.

Wood Blocks.

Tampons en Bois.

Tacos de Madera.

Деревянные Закрѣпы.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Accessories for accumulators, arc lamps, batteries, telephones, etc., see under those headings.

Accessoires pour accumulateurs, lampes à arc, batteries, téléphones, etc., voir ces mots.

Accesorios para acumuladores, lámparas de arco, baterías, teléfonos, etc., véanse estas palabras.

Принадлежности для аккумуляторовъ, дуговыхъ лампъ, батарей, телефоновъ, и пр., см. эти слова.

ACCUMULATORS.

ACCUMULATEURS.

ACUMULADORES.

АККУМУЛЯТОРЫ.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
D.P. BATTERY CO. LTD
TUDOR ACCUMULATOR CO., LTD.
PRITCHETTS & GOLD AND ELECTRIC POWER STORAGE CO., LTD.

Accumulator Switches and Switchboards, see under "Switchgear."

Commutateurs et Tableaux de Distribution pour Accumulateurs, voir "Appareils de Distribution."

Conmutadores y Cuadros de Distribución para Acumuladores, véase "Aparatos de Distribución."

Аккумуляторные Коммутаторы и Распредѣлительныя доски, см. „Распредѣлительныя Устройства".

ACCUMULATORS (Heat, Regenerative).

ACCUMULATEURS de Chaleur Régénérative.

ACUMULADORES de Calor Regenerativo.

АККУМУЛЯТОРЫ Регенеративаго Тепла.

RICHARDSONS WESTGARTH & CO., LTD.

AIR COMPRESSORS, see "Compressors."

COMPRESSEURS d'AIR, voir "Compresseurs."

COMPRESORES de AIRE, véase "Compresores."

ВОЗДУШНЫЕ КОМПРЕССОРЫ, см. „Компрессоры".

AIR FILTERS.

Filtres d'Air.

Filtros de Aire.

Воздушные Фильтры.

PREMIER COOLER & ENGINEERING CO., LTD.

ALTERNATORS, see "Generators."

ALTERNATEURS, voir "Génératrices."

ALTERNADORES, véase "Generadores."

АЛЬТЕРНАТОРЫ, см. „Генераторы".

ARC LAMPS and Accessories.

LAMPES à ARC et Accessoires.

LAMPARAS de ARCO y Accesorios.

ДУГОВЫЯ ЛАМПЫ или ФОНАРИ и Принадлежности.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Standards.

Poteaux de Lampes à Arc.

Columnas de Lámparas de Arco.

Столбы для Дуговыхъ Лампъ.

BERRY, SKINNER & CO
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD

Arc Lamp Winches.

Treuils de Levage pour Lampes à Arc.

Tornos de Elevación para Lámparas de Arco.

Лебедки для Дуговыхъ Лампъ.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Carbons, see under " Carbons."
Crayons de Lampes à Arc, voir " Crayons."
Carbones para Lámparas de Arco, véase " Carbones "
Угли для Дуговыхъ Лампъ, см. ,,Угли".

Arc Lamp Globes, see under " Glassware."
Globes de Lampes à Arc, voir " Verreries."
Globos de Lámpara de Arco, véase " Cristalería "
Шары для Дуговыхъ Лампъ, см. ,, Стеклянная Посуда".

AUTOMOBILE SWITCHBOARDS.

TABLEAUX de DISTRIBUTION pour AUTOMOBILES.
CUADROS de DISTRIBUCION para AUTOMOVILES.
КОММУТАЦIОННЫЯ ДОСКИ для АВТОМОБИЛЕЙ.

LUNDBERG, A. P., & SONS.

BATTERIES, Primary and Accessories.

BATTERIES, Primaires et Accessoires.
BATERIAS, Primarias y Accesorios.
БАТАРЕИ Первичныя и Принадлежности

Dry Cells.
Piles Sèches.
Pilas Secas.
Cyxie Элементы.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.
SUN ELECTRICAL CO., LTD.

Ignition Cells.
Piles d'Allumage.
Pilas de encender.
Зажигательныя Батареи.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD
SIEMENS BROS. & CO. LTD.

Wet Cells (Leclanché, etc.).
Piles Hydroélectriques (Leclanché, etc.).
Pilas Hidroeléctricas (Leclanché, etc.).
Мокрые Элементы (Лекланше и др.).

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

BELLS, see under " Accessories."

SONNERIES, voir " Accessoires."
CAMPANILLAS, véase " Accessorios."
ЗВОНКИ, см. ,,Принадлежности".

BLOWERS, see COMPRESSORS.

SOUFFLERIES, voir **COMPRESSEURS.**
SOPLADORES, véase **COMPRESORES.**
ВОЗДУХОДУВКИ, см. **КОМПРЕССОРЫ.**

BOILERS and Boiler Equipments.

CHAUDIERES et Accessoires de Chaudières.
CALDERAS y Accesorios de Calderas.
КОТЛЫ и Котельная Арматура.

CLARKE, CHAPMAN & CO., LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.

BOOSTERS, see under " Generators."

SURVOLTEURS, voir " Génératrices."
ELEVADORES de TENSION, véase " Generadores."
ПОВЫСИТЕЛИ НАПРЯЖЕНIЯ (БУСТЕРЫ), см. ,,Генераторы".

BRAKES (Magnetic).

FREINS Magnétiques.
FRENOS Magnéticos.
Магнитные ТОРМАЗА.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.

BRUSHES, Carbon, for Electrical Machinery.

BALAIS en Carbone pour Appareils Electriques.
ESCOBILLAS de Carbón para Aparatos Eléctricos.
УГОЛЬНЫЯ ЩЕТКИ для Электрическихъ Машинъ.

MORGAN CRUCIBLE CO., LTD.

CABLES (see also " Wires ") and Cable Accessories.

CÂBLES (voir aussi " Fils ") et Accessoires de Câbles.
CABLES (véase también " Alambres ") y Accesorios de Cables.
КАБЕЛИ (см. также ,,Провода") и Принадлежности.

Paper Insulated Cables.
Câbles Isolés au Papier.
Cables Aislados con Papel.
Кабели съ Бумажной Изоляцiей.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD
JOHNSON & PHILLIPS, LTD.
PIRELLI, LTD
SIEMENS BROS. & CO., LTD.

Rubber Insulated Cables.
Câbles Isolés au Caoutchouc.
Cables Aislados con Caucho.
Кабели съ Резиновой Изоляцiей.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Submarine Cables.
Câbles Sous-Marins.
Cables Submarinos.
Подводные Кабели.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Telephone Cables.
Câbles Téléphoniques.
Cables Telefónicos.
Телефонные Кабели.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Junction Boxes.
Boîtes de Dérivation.
Cajas de Derivación.
Отвѣтвительныя Коробки.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
LUCY, W., & CO.
SIEMENS BROS. & CO., LTD.

Expansion Joints.
Joints Extensibles.
Empalmes Extensibles.
Растяжимыя Соединенія.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. & CO., LTD.

CARBONS.
CHARBONS.
CARBONES.
УГЛИ.

For Arc Lamps.
Pour Lampes à Arc.
Para Lámparas de Arco.
Для Дуговыхъ Лампъ.
CROMPTON & CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Carbon Brushes, see under "Brushes."
Balais en Carbone, voir "Balais."
Escobillas de Carbón, véase "Escobillas."
Угольныя Щетки, см. „Щетки".

Carbon Crucibles, see under "Crucibles."
Creussets en Carbone, voir "Creusets."
Crisoles de Carbón, véase "Crisoles."
Тигли Угольные, см. „Тигли".

CEILING ROSES, see under "Accessories."
ROSACES DE PLAFOND, voir "Accessoires."
ROSETONES DE TECHO, véase "Accesorios."
ПОТОЛОЧНЫЯ РОЗЕТКИ, см. „Принадлежности".

CELLS, see "Accumulators" and "Batteries."
PILES, voir "Accumulateurs" et "Batteries."
PILAS, véase "Acumuladores" y "Baterías."
ЭЛЕМЕНТЫ, см. „Аккумуляторы" и „Батареи"

CLOCKS, Electrically driven.
HORLOGES Electriques.
RELOJES Eléctricos.
ЧАСЫ Электрическіе.
ARON ELECTRICITY METER, LTD.
VENNER & CO.

COLLIERIES, Equipment of, see "Mines."
HOUILLERES, Equipements de, voir "Mines."
HULLERAS, Equipos de, véase "Minas."
КАМЕННОУГОЛЬНЫЯ КОПИ, ихъ оборудованіе, см. „Рудники".

COMPRESSORS AND BLOWERS.
COMPRESSEURS et SOUFFLERIES.
COMPRESORES y SOPLADORES.
КОМПРЕССОРЫ и ВОЗДУХОДУВКИ.
ALLEN, W. H., SON & CO., LTD.
ALLEY & MACLELLAN, LTD.
BELLISS & MORCOM LTD.
BRITISH THOMSON HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
BROWETT, LINDLEY & CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
PARSONS, C. A., & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD

CONDENSERS, ELECTRICAL.
CONDENSATEURS ELECTRIQUES.
CONDENSADORES ELECTRICOS.
КОНДЕНСАТОРЫ ЭЛЕКТРИЧЕСКІЕ.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
GENERAL ELECTRIC CO., LTD
HICK, HARGREAVES & CO., LTD.
JOHNSON & PHILLIPS, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
SIEMENS BROS. & CO., LTD.

CONDENSERS, STEAM.
CONDENSEURS de VAPEUR.
CONDENSADORES de VAPOR.
КОНДЕНСАТОРЫ ПАРОВЫЕ.

ALLEN, W. H., SON & CO., LTD.
ASHWORTH & PARKER.
BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
HICK, HARGREAVES & CO., LTD
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD
WILLANS & ROBINSON; LTD
WORTHINGTON PUMP CO., LTD.

CONDUITS and Conduit Fittings.
TUBES ISOLANTS et Accessoires pour Tubes.
TUBOS AISLADORES y Accesorios para Tubos.
ИЗОЛЯЦІОННЫЯ ТРУБКИ и ихъ Принадлежности.

CREDENDA CONDUITS CO. LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS LTD

CONTROL GEAR.
APPAREILS CONTROLEURS.
APARATOS DE COMPROBACION.
КОНТРОЛЬНЫЕ АППАРАТЫ.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM-REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTRIC CONTROL LTD. (Automatic Control Gear only).
ELECTRICAL APPARATUS CO., LTD.
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO. LTD.
JOHNSON & PHILLIPS, LTD
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REYROLLE & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
WEST, ALLEN, & CO., LTD.
WHIPP & BOURNE.

Controllers for Crane Motors.
Contrôleurs pour Moteurs de Grues.
Controleres para Motores de Grúas.
Контролеры для Крановыхъ Моторовъ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
ECKSTEIN, HEAP & CO., LTD
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELLISON, GEORGE.
IGRANIC ELECTRIC CO., LTD.
WEST, ALLEN, & CO., LTD

Controllers for Traction Work.
Contrôleurs pour Moteurs de Tramway.
Controleres para Motores de Tranvia.
Контролеры для Трамвайныхъ Моторовъ.

BRITISH THOMSON-HOUSTON CO. LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELLISON, GEORGE.
SIEMENS BROS. DYNAMO WORKS, LTD
WEST, ALLEN, & CO., LTD.

Motor Starters and Panels.
Démarreurs et Tableaux de Démarrage pour Moteurs.
Aparatos y Cuadros de Arranque para Motores.
Пусковые Аппараты и Доски для Моторовъ.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
BROOK, HIRST & CO., LTD
BRUSH ELECTRICAL ENGINEERING CO., LTD
CROMPTON & CO., LTD.
DICK, KERR & CO. LTD
ELECTRICAL APPARATUS CO., LTD
ELECTRIC & ORDNANCE ACCESSORIES CO LTD.
ELLISON, GEORGE.
FERRANTI, LTD
GENERAL ELECTRIC CO., LTD
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
MORRIS & LISTER, LTD.
REYROLLE, A., & CO., LTD
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Rheostats.
Rhéostats.
Reostatos.
Реостаты.

BERRY, SKINNER & CO.
BOOTHROYD, H T., LTD
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD
BRUSH ELECTRICAL ENGINEERING CO., LTD
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO, LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLIOTT BROTHERS
ELLISON, GEORGE
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD
MAVOR & COULSON, LTD
NALDER BROS. & THOMPSON LTD.
PAUL, ROBERT W.
REYROLLE, A., & CO, LTD.
SANDYCROFT, LTD.
SIEMENS BROS DYNAMO WORKS LTD.
SWITCHGEAR & COWANS, LTD
WEST, ALLEN, & CO., LTD.
WHIPP & BOURNE.

CONVERTERS (Motor).
TRANSFORMATEURS en CASCADE
TRANSFORMADORES en CASCADA
КАСКАДНЫЕ КОНВЕРТЕРЫ

(PEEBLES—LA COUR PATENTS)
PEEBLES, BRUCE, & CO, LTD.
SANDYCROFT, LTD.

CONVERTERS, ROTARY.
COMMUTATRICES.
CONVERTIDORES ROTATORIOS.
ВРАЩАЮЩІЕСЯ КОНВЕРТЕРЫ (ПРЕОБРАЗОВАТЕЛИ).

BOOTHROYD, H. T. LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO, LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.
WRIGHT & WOOD, LTD.

Converters, Static, see " Transformers."
Transformateurs Statiques, voir " Transformateurs."
Transformadores Estáticos, véase " Transformadores."
Статическіе Преобразователи, см.,, Трансформаторы".

COOKING APPLIANCES, ELECTRICAL, see " Heating and Cooking."
USTENSILES ELECTRIQUES de CUISINE, voir " Chauffage et Cuisine."
UTENSILIOS ELECTRICOS de COCINA, véase "Caldeo y Cocina."
ЭЛЕКТРИЧЕСКІЕ КУХОННЫЕ ПРИБОРЫ, см. ,,Отопленіе и Кухонные Приборы".

CRANE EQUIPMENTS, see also " Control Gear," " Motors," etc.
EQUIPEMENT DE GRUES, voir aussi " Appareils Contrôleurs," " Moteurs," etc.
EQUIPOS DE GRUAS, véase también " Aparatos de Comprobación," Motores," etc.
СНАРЯЖЕНІЕ для КРАНОВЪ, см. также ,,Контрольные Аппараты", ,,Моторы" и пр.

BOOTHROYD H. T., LTD.
BRITISH ELECTRIC PLANT CO. LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
BRUSH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTROMOTORS, LTD.
ELLISON, GEORGE.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PHŒNIX DYNAMO MANUFACTURING CO, LTD.
SANDYCROFT, LTD.
WEST, ALLEN & CO., LTD.

CRUCIBLES, Electric.
CREUSETS Electriques.
CRISOLES Eléctricos.
ТИГЛИ Электрическіе.

MORGAN CRUCIBLE CO., LTD.

CUT-OUTS, see " Accessories."
COUPE-CIRCUITS, voir " Accessoires."
CORTACIRCUITOS, véase " Accesorios."
ПРЕДОХРАНИТЕЛИ, см. ,,Принадлежности".

DISTRIBUTION BOARDS, see also "Switchgear."

TABLEAUX DE DISTRIBUTION, voir aussi "Appareils de Distribution."

CUADROS DE DISTRIBUCION, véase también "Aparatos de Distribución."

РАСПРЕДѢЛИТЕЛЬНЫЯ ДОСКИ, см. также ,,Распредѣлительныя Устройства".

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
SUN ELECTRICAL CO., LTD.
SWITCHGEAR & COWANS, LTD.

DOMESTIC APPLIANCES, see also "Heating and Cooking," "Fans," etc.

APPAREILS DOMESTIQUES, voir aussi "Chauffage et Cuisine," "Ventilateurs," etc.

APARATOS DOMESTICOS, véase también "Caldeo y Cocina," "Ventiladores," etc.

ДОМОВЫЯ УСТАНОВКИ, см. также ,,Отопленіе и Освѣщеніе", ,,Вентиляторы" и пр.

BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
SUN ELECTRICAL CO., LTD.

Vacuum Cleaners.

Nettoyeuses au Vide.

Limpiadores de Vacío.

Пылесосы.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.

DRILLS, Electrically driven.

FOREUSES Electriques.

PERFORADORES Eléctricos.

Электрическіе СВЕРЛИЛЬНЫЕ СТАНКИ.

BOOTHROYD, H. T., LTD.
REES, ROTURBO MANUFACTURING CO., LTD.

Portable Drilling Machines.

Foreuses Portatives.

Perforadores Portátiles.

Переносные Сверлильные Станки.

BOOTHROYD, H. T., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
REES ROTURBO MANUFACTURING CO., LTD.

DYNAMOS, see "Generators."

DYNAMOS, voir "Génératrices."

DINAMOS, véase "Generadores."

ДИНАМО, см. ,,Генераторы".

ENGINES, see "Prime Movers."

MACHINES, voir "Machines Motrices."

MAQUINAS, véase "Máquinas Motoras."

ДВИГАТЕЛИ, см. это слово.

FANS.

VENTILATEURS.

VENTILADORES.

ВЕНТИЛЯТОРЫ.

Bracket Fans.

Ventilateurs à Console.

Ventiladores de Consola.

Консольные Вентиляторы.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO., LTD
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD

Ceiling Fans.

Ventilateurs de Plafond.

Ventiladores de Techo.

Потолочные Вентиляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD
PARSONS, C. A., & CO.
SUN ELECTRICAL CO., LTD.

Table Fans.

Ventilateurs de Table.

Ventiladores de Mesa.

Настольные Вентиляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.

PARSONS C. A., & CO.
SUN ELECTRICAL CO., LTD

Ventilating Fans.
Ventilateurs Extracteurs.
Ventiladores Extractores.
Вытяжные Вентиляторы.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
HOWDEN, JAMES & CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

FITTINGS for Electric Light.
ACCESSOIRES pour Lumière Electrique.
ACCESORIOS para Luz Eléctrica.
ПРИНАДЛЕЖНОСТИ для Электрическаго Свѣта.

Brackets.
Appliques.
Brazos.
Кронштейны.

BRITISH THOMSON-HOUSTON CO., LTD
CREDENDA CONDUITS CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Fittings.
Accessoires de Plafond.
Accesorios de Techo.
Потолочныя Гарнитуры.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Counterweights.
Contrepoids.
Contrapesos.
Противовѣсы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Electroliers.
Lustres.
Arañas.
Люстры.

BRITISH THOMSON-HOUSTON CO., LTD
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Fancy Shades.
Abat-Jour Artistiques.
Pantallas Artisticas.
Декоративные Абажуры.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Hand Lamps.
Lampes à Main.
Lámparas de Mano.
Ручныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
DAY, ST. JOHN, (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Lanterns.
Lanternes.
Linternas.
Фонари.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO LTD.

Pendants.
Lampes à Suspension.
Lámparas de Suspensión.
Подвѣсныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD

Reflectors.
Reflecteurs.
Reflectores.
Рефлекторы.

BRITISH THOMSON-HOUSTON CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
DAY, ST. JOHN, (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD
PARSONS, C. A., & CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Standard Lamps.
Lampes Portatives.
Lámparas Portátiles.
Переносныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.

SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Street Fittings.

Matériel pour Eclairage Public.

Material para Alumbrado Público.

Матеріалъ для Уличнаго Освѣщенія.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Watertight Fittings for Mines, Dockyards, Shipwork, etc.

Accessoires Hermétiques pour Mines, Chantiers de Construction Navale, Navires, etc.

Accesorios Erméticos para Minas, Astilleros Buques, etc.

Водонепроницаемыя Устройства для Рудниковъ, Верфей, Судовъ и пр.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
REYROLLE, A. & CO., LTD.
SIEMENS BROS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Carbons for Electric Furnaces, see "Carbons."

Electrodes pour Fours Electriques, voir "Crayons."

Electrodes para Hornos Eléctricos, véase "Carbones,"

Электроаы для Электрическихъ Печей, см. „Угли".

FUSES.

FUSIBLES.

FUSIBLES.

ЛЕГКО-ПЛАВКІЯ ВСТАВКИ.

BERRY, SKINNER & CO.
BRITISH THOMSON HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC CONTROL, LTD. (High Tension)
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
LUCY, W., & CO., LTD.
NALDER BROS. & THOMPSON LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REASON MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

GENERATORS, A.C. and D.C.

GENERATRICES, à C.C. et à C.A.

GENERADORES, de C.C. y C.A.

ГЕНЕРАТОРЫ Пост. и Перем. Тока.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PARSONS, C. A., & CO.
PEEBLES, BRUCE, & CO. LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD
WESTMINSTER ENGINEERING CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Boosters.

Survolteurs.

Elevadores de Tensión.

Повысители Напряженія (Бустеры).

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD

Generators for Electro-Plating.

Génératrices pour Galvanoplastie.

Generadores para Galvanoplastia.

Генераторы для Гальванопластики.

BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.

MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Motor-Generators.
Moteurs-Générateurs.
Motores-Generadores.
Двигатели-Генераторы.

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SANDYCROFT, LTD.
VICKERS, LTD.

Turbo-Alternators.
Turbo-Alternateurs.
Turbo-Alternadores.
Турбо-Альтернаторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELEC. & MANUFACTURING CO. LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO. LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO. LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Continuous Current Turbo-Generators.
Turbo-Génératrices à Courant Continu.
Turbo-Dinamos de Corriente Continua.
Турбо-Генераторы Пост. Тока.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
MATHER & PLATT, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

GLASSWARE.
VERRERIES.
CRISTALERIA.
СТЕКЛЯННАЯ ПОСУДА.

Arc Lamp Globes.
Globes de Lampes à Arc.
Globos de Arco.
Шары для Дуговыхъ Лампъ.

Glass Shades.
Abat-Jour en Verre.
Pantallas de Vidrio.
Стеклянные Абажуры.

Holophane Ware.
Verreries Holophanes.
Cristaleria Holófana.
Голофанная Посуда.

MOST MEMBERS OF THE B.E.A.M.A. SELL THESE WARES

HEATING AND COOKING APPLIANCES, Electrical.
APPAREILS Electriques de **CHAUFFAGE** et de **CUISINE.**
APARATOS Eléctricos de **CALDEO** y de **COCINA.**
Электрическіе **НАГРѢВАТЕЛЬНЫЕ и КУХОННЫЕ ПРИБОРЫ.**

CREDENDA CONDUITS CO., LTD.
BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO. LTD
CROMPTON & CO., LTD
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO. LTD
PARK ROYAL ENGINEERING WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

Radiators, see this word under main headings.
Radiateurs, voir ce mot.
Radiadores, véase esta palabra.
Радіаторы, см. это слово.

INCANDESCENT LAMPS, see "Lamps."
LAMPES à INCANDESCENCE, voir "Lampes."
LAMPARAS de INCANDESCENCIA, véase "Lámparas."
ЛАМПЫ НАКАЛИВАНІЯ, см. „Лампы".

INDUCTION COILS, see "Medical Electro-Appliances" and "Wireless Telegraphy Appliances."
BOBINES d'INDUCTION, voir "Appareils Electro-Médicaux" et "Appareils de Télégraphie sans Fil."
CARRETES de INDUCCION, véase "Aparatos Eléctro-Medicales" y "Aparatos de Telegrafía sin Alambres."
ИНДУКЦІОННЫЯ КАТУШКИ, см. „Электро-Медицинскіе Аппараты" и „Радіо-Телеграфные Аппараты".

INSTRUMENTS, see also "Testing Sets."
INSTRUMENTS, voir aussi "Appareils de Laboratoire."
INSTRUMENTOS, véase también "Aparatos de Laboratorio."
ИНСТРУМЕНТЫ, см. также „Приборы для Испытанія".

Indicating Instruments (Ammeters, Voltmeters, Wattmeters, Phasemeters, Frequency Indicators, etc.).
Instruments de Mesure (Ampèremètres, Voltmètres, Wattmètres, Phasemètres, Fréquencemètres, etc.).
Instrumentos de Medida (Amperómetros, Voltímetros, Vatímetros, Fasómetros, Frecuencímetros, etc.).

Контрольные Аппараты (Амперметры, Вольтметры, Ваттметры, Фазометры, Частометры и др.).

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO. LTD.
ECKSTEIN, HEAP & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD
JOHNSON & PHILLIPS LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD
PAUL, ROBERT W
RECORD ELECTRICAL CO. LTD
SIEMENS BROS. & CO., LTD.

Instrument Transformers.

Transformateurs de Mesure.

Transformadores de Medida.

Измѣрительные Трансформаторы.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SWITCHGEAR & COWANS, LTD

Recording Instruments.

Instruments Enregistreurs.

Instrumentos Registradores.

Самопишущіе Приборы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ECKSTEIN HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.

Instruments, Integrating, see "Meters."

Compteurs Totalisateurs, vior "Compteurs."

Contadores Integradores, véase "Contadores."

Счетчики-Интеграторы, см. „Счетчики“.

INSULATORS.

ISOLATEURS.

AISLADORES.

ИЗОЛЯТОРЫ.

Porcelain Insulators.

Isolateurs en Porcelaine.

Aisladores de Porcelana.

Фарфоровые Изоляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
IGRANIC ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Suspension Insulators.

Isolateurs de Suspension.

Aisladores de Suspensión.

Подвѣсные Изоляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
SIEMENS BROS. & CO., LTD.

Tramway Insulators for Overhead Lines.

Isolateurs de Tramway pour Lignes Aériennes.

Aisladores de Tranvia para Líneas Aéreas.

Изоляторы для Трамвайныхъ Воздушныхъ Линій.

BRITISH INSULATED & HELSBY CABLES, LTD
BRITISH THOMSON-HOUSTON CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.

INSULATING MATERIAL.

MATIERES ISOLANTES.

MATERIALES AISLANTES.

ИЗОЛЯЦІОННЫЕ МАТЕРІАЛЫ.

Press Spahn and other Materials.

Cartons Comprimés et autres Matières

Cartones Comprimidos y otros Materiales.

Прессованные Картоны и др. Матеріалы.

BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
DAY, ST. JOHN (PATENTS), LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO. LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PIRELLI, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

JUNCTION BOXES, see "Cables" and "Conduits."

BOITES de DERIVATION, voir "Cables" et "Tubes Isolants."

CAJAS de DERIVACION, véase "Cables" y "Tubos Aisladores."

ОТВѢТВИТЕЛЬНЫЯ КОРОБКИ, см. „Кабели" и „Изоляц. Трубки".

LAMPS, see also "Arc Lamps."

LAMPES, voir aussi "Lampes à Arc."

LAMPARAS, véase también "Lámparas de Arco."

ЛАМПЫ,см. также „Дуговыя Лампы".

Incandescent Lamps (Carbon Filament, Metallic Filament, and Drawn Wire Lamps).

Lampes à Incandescence (à Filament en Carbone, à Filament Métallique et à Fil Etiré).

Lámparas de Incandescencia (con Filamento de Carbón, Filamento metálico, y con Alambre Estirado).

Лампы Накаливанія (съ Угольной Нитью,Металлической Нитью и съ Тянутой Проволокой).

BRITISH THOMSON-HOUSTON CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
OSRAM-ROBERTSON LAMP WORKS, LTD.
SIEMENS BROS. & CO., LTD.
SIEMENS BROS DYNAMO WORKS LTD.
SUN ELECTRICAL CO., LTD.

LAMPHOLDERS, see "Accessories."

DOUILLES, voir "Accessoires."

PORTALAMPARAS, véase "Accesorios."

ПАТРОНЫ, см. „Принадлежности".

LANTERNS, see "Fittings."

LANTERNES, voir "Garnitures."

LINTERNAS, véase "Guarniciones."

ФОНАРИ, см. „Гарнируры".

LIFT MOTORS, see "Motors."

Moteurs d'Ascenseurs, voir "Moteurs."

Motores para Ascensores, véase "Motores"

Подъемные Моторы, см. „Моторы".

LIGHTNING ARRESTERS.

PARAFOUDRES.

PARARRAYOS.

ГРОМООТВОДЫ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EVERETT, EDGCUMBE & CO. LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO, LTD.
JOHNSON & PHILLIPS, LTD.
PARK ROYAL ENGINEERING WORKS, LTD
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.

MAGNETOS.

MAGNÉTOS.

MAGNETOS.

МАГНЕТА.

BRITISH THOMSON-HOUSTON CO. LTD

MAGNETS, LIFTING.

ELECTRO-AIMANTS.

ELECTRO-IMANES.

ЭЛЕКТРО-МАГНИТЫ.

ECKSTEIN HEAP & CO., LTD.
ELECTRIC CONTROL LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO LTD.
MORRIS & LISTER, LTD
PARK ROYAL ENGINEERING WORKS, LTD.

MAGNETS, PERMANENT.

AIMANTS PERMANENTS.

IMANES PERMANENTES.

ПОСТОЯННЫЕ МАГНИТЫ.

NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS LTD

MEDICAL, ELECTRO-APPLIANCES.

APPAREILS ELECTRO-MEDICAUX.

APARATOS ELECTRO-MEDICALES.

ЭЛЕКТРО-МЕДИЦИНСКІЕ АППАРАТЫ.

Induction Coils.

Bobines d'Induction.

Carretes de Inducción.

Индукціонныя Катушки.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

X-Ray Outfits.

Radiomètres pour Rayons X.

Radiómetros para Rayos Roentgen.

Приборы для Рентгеновскихъ Лучей.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. & CO., LTD.

METERS

COMPTEURS.

CONTADORES.

СЧЕТЧИКИ.

ARON ELECTRICITY METER, LTD

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

Ampère-Hour Meters.
Ampères-Heures-Mètres.
Contadores de Amperios-Horas.
Счетчики Амперъ-Часовъ.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. LTD.
CHAMBERLAIN & HOOKHAM, LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD
FERRANTI, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

Watt-Hour Meters.
Watts-Heures-Mètres.
Contadores de Vatio-Horas.
Счетчики Ваттъ-Часовъ.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
NALDER BROS. & THOMPSON, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

MINES, Equipments for
Equipement pour **MINES.**
Equipos para **MINAS.**
РУДНИЧНЫЯ Оборудованія.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
FRASER & CHALMERS, LTD.
GLOVER, W. T., & CO., LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
VICKERS, LTD.
WEST, ALLEN & CO., LTD.

Flameproof Motors.
Moteurs Etanches au Gaz.
Motores Estancos al Gas.
Газонепроницамые Безопасные Моторы.

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON, CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Haulage Gear.
Appareils de Halage.
Aparatos de Tracción.
Транспортныя Устройства.

BRITISH ELECTRIC PLANT CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD
PARSONS, C. A., & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD
SANDYCROFT, LTD.
VICKERS, LTD.

Winding Engines.
Machines d'Extraction.
Máquinas de Extracción.
Рудничныя Лебедки.

BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD
FRASER & CHALMERS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS DYNAMO WORKS, LTD.
VICKERS, LTD.

Mine and Watertight Fittings, see "Fittings for Electric Light."

Accessoires Etanches pour Mines, voir "Accessoire pour Lumière Electrique."

Accesorios Estancos para Minas, véase "Accesorios para Luz Eléctrica."

Рудничныя Водонепроцинаемыя Принадлежности, см. „Принадлежности для Электр. Освѣщ."

Mining Switchgear, see "Switchgear."

Appareils de Distribution pour Mines, voir "Appareils de Distribution."

Aparatos de Distribución para Minas, véase "Aparatos de Distribución."

Рудничныя Распредѣлительныя Устройства, см. „Распр. Устройства".

Mine and Sinking Pumps, see "Pumps."

Pompes d'Exhaure pour Mines, etc., voir "Pompes."

Bombas para Minas, Pozos, etc., véase "Bombas."

Рудничные и Артезіанскіе Насосы, см. „Насосы".

Miners' Safety Lamps, see "Lamps."

Lampes de Sûreté de Mineurs, voir "Lampes."

Lámparas de Seguridad de Mineros, véase "Lámparas."

Рудничныя Лампы, см. „Лампы".

MOTORS for A.C. and D.C.

MOTEURS pour C.C. et C.A.

MOTORES para C.C. y C.A.

МОТОРЫ для Перем. и Пост. Тока.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Crane Motors.

Moteurs de Grues.

Motores de Grúas.

Крановые Моторы.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CROMPTON & CO LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS LTD.
VICKERS, LTD.

Lift Motors.

Moteurs d'Ascenseurs.

Motores para Ascensores.

Лифтовые Моторы.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO, LTD.
BRITISH THOMSON-HOUSTON CO, LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD
RHODES MOTORS, LTD
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WILSON-WOLF ENGINEERING CO., LTD

Motor Converters, see "Converters (Motor)."

Transformateurs en Cascade, voir ce mot.

Transformadores en Cascada, véase esta palabra.

Каскадные Конвертеры, см. это слово.

Motor Starters and Panels, see "Control Gear."

Motors, Petrol, see "Prime Movers."

Moteurs à Essence, voir "Machines Motrices."

Motores de Bencina, véase "Máquinas-Motoras."

Бензиновые Двигатели, см. „Двигатели".

Motors, Tramway and Railway, see " Traction."

Moteurs pour Tramways et Chemins de Fer, voir " Traction."

Motores para Tranvias y Ferrocarriles, véase " Tracción."

Трамвайные и Желѣзнодорожные Моторы, см. Подвижные Составы.

NOVELTIES, Advertising and other.

NOUVEAUTES pour Réclames, etc.

NOVEDADES para Reclamos, etc.

НОВОСТИ для Рекламныхъ Цѣлей и др.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

PENDANTS, see " Fittings."

LAMPES à SUSPENSION, voir " Garnitures."

LAMPARAS de SUSPENSION, véase " Guarniciones."

ПОДВѢСНЫЯ ЛАМПЫ, см. „Гарнитуры".

PHOTOMETERS.

PHOTOMETRES.

FOTOMETROS.

ФОТОМЕТРЫ.

ELLIOTT BROTHERS
EVERETT, EDGCUMBE & CO., LTD.

PRIME MOVERS.

MACHINES MOTRICES.

MAQUINAS-MOTORAS.

ДВИГАТЕЛИ.

Diesel Engines.

Moteurs Diesel.

Motores Diesel.

Двилатели Дизеля.

BELLISS & MORCOM, LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
HICK, HARGREAVES & CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON, LTD.

Gas Engines.

Moteurs à Gaz.

Motores de Gas.

Газовые Двигатели.

ALLEN, W. H., SON & CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
RICHARDSONS, WESTGARTH & CO., LTD

Petrol and Oil Engines.

Moteurs à Pétrole et à Essence.

Motores de Bencina y de Aceite.

Бензиновые и Нефтяные Двигатели.

ALLEN, W. H., SON & CO., LTD
BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.

Reciprocating Steam Engines.

Machines à Vapeur à Piston.

Máquinas de Vapor de Embolo.

Поршневыя Паровыя Машины.

ALLEN, W. H., SON & CO., LTD.
ASHWORTH & PARKER.
BELLISS & MORCOM, LTD.
BROTHERHOOD, PETER, LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CLARKE, CHAPMAN & CO., LTD
COLE, MARCHENT & MORLEY, LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
HOWDEN, JAMES & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
SANDYCROFT, LTD.

Steam Turbines.

Turbines à Vapeur.

Turbinas de Vapor.

Паровыя Турбины.

ALLEN, W. H., SON & CO., LTD.
BELLISS & MORCOM, LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD PETER, LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
FRASER & CHALMERS, LTD.
GREENWOOD & BATLEY, LTD.
HOWDEN, JAMES & CO., LTD.
PARSONS, C. A., & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.

Water Turbines.

Turbines Hydrauliques.

Turbinas Hidráulicas.

Водяныя Турбины.

ASHWORTH & PARKER.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FRASER & CHALMERS, LTD

PUMPS.

POMPES.

BOMBAS.

НАСОСЫ.

Centrifugal Pumps.

Pompes Centrifuges.

Bombas Centrifugas.

Центробѣжные Насосы.

ALLEN, W. H., SON & CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.

BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
FRASER & CHALMERS LTD.
MATHER & PLATT, LTD
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON LTD.
WORTHINGTON PUMP CO., LTD.

Plunger Pumps
Pompes à Piston.
Bombas de Embolo.
Плунжерные Насосы.

CLARKE, CHAPMAN & CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO. LTD
FRASER & CHALMERS, LTD
MIRRLEES WATSON CO., LTD.
PARSONS, C. A, & CO., LTD
SANDYCROFT, LTD.
WORTHINGTON PUMP CO., LTD.

Rotary Pumps.
Pompes Rotatives.
Bombas Rotativas.
Ротацiонные Насосы.

ALLEN, W. H., SON & CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
MATHER & PLATT, LTD.
MIRRLEES WATSON CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

Sinking Pumps.
Pompes d'Exhaure.
Bombas para Minas.
Рудничные Насосы.

BRITISH ELECTRIC PLANT CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WORTHINGTON PUMP CO., LTD.

Turbine Pumps for High Lifts.
Pompes à Turbines Etagées pour H.P.
Bombas de Turbina en Grados para A.P.
Турбо-Насосы для Высокаго Давленiя.

ALLEN, W. H., SON & CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRITISH ELECTRIC PLANT CO. LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

PUSHES, see " Accessories."
BOUTONS, voir " Accessoires."
BOTONES, véase " Accesorios."
ЗВОНКОВЫЯ КНОПКИ, см. „Принадлежности".

PYROMETERS.
PYROMETRES.
PIROMETROS.
ПИРОМЕТРЫ.

CROMPTON & CO., LTD.
PAUL, ROBERT W
SIEMENS BROS. & CO., LTD.

RADIATORS, see also " Heating and Cooking."
RADIATEURS, voir aussi " Chauffage et Cuisine."
RADIADORES, véase también " Caldeo y Cocina."
РАДIАТОРЫ, см. также „Отопленiе Кухонные Приборы".

BERRY, SKINNER & CO.
BRITISH ELECTRIC TRANSFORMER CO., LTD
BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

RADIATOR LAMPS, see " Lamps."
LAMPES pour RADIATEURS, voir " Lampes."
LAMPARAS para RADIADORES, véase " Lámparas."
ЛАМПЫ для РАДIАТОРОВЪ, см. Лампы.

REFLECTORS, see " Fittings for Electric Light."
REFLECTEURS, voir " Accessoires pour Lumière Electrique."
REFLECTORES, véase "Accesorios para Luz Eléctrica."
РЕФЛЕКТОРЫ, см. „ Принадлежности для Электр. Свѣта."

RELAYS, see also " Instruments " and " Control Gear."
RELAIS, voir " Instruments " et " Appareils Contrôleurs."
RELEVADORES, véase " Instrumentos " y " Aparatos de Comprobación."
РЕЛЭ, см. „Инструменты" и „Контрольные Аппараты".

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
CROMPTON & CO., LTD
ECKSTEIN, HEAP & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
NALDER BROS. & THOMPSON, LTD
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. & CO., LTD
SWITCHGEAR & COWANS, LTD.

RHEOSTATS, see "Control Gear."
RHEOSTATS, voir "Appareils Contrôleurs."
REOSTATOS, véase "Aparatos de Comprobación."
РЕОСТАТЫ, см. ,,Контрольные Аппараты".

ROLLING MILLS, Electrical Equipment of.
Equipement Electrique de **LAMINOIRS.**
Equipos Eléctricos de **LAMINADORES.**
ВАЛЬЦОВКИ, ихъ Электр. Оборудованіе.

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC CONTROL, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE & CO., LTD
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

ROTARY CONVERTERS, see "Converters, Rotary."
COMMUTATRICES, voir ce mot.
CONVERTIDORES ROTATORIOS, véase esta palabra.
ВРАЩАЮЩІЕСЯ КОНВЕРТЕРЫ (ПРЕОБРАЗОВАТЕЛИ), см. ,,Конвертеры".

SAFETY LAMPS, see "Lamps."
LAMPES de MINEURS, voir "Lampes."
LAMPARAS de MINEROS, véase "Lámparas."
БЕЗОПАСНЫЯ ЛАМПЫ, см. Лампы.

SEARCHLIGHT PROJECTORS.
PROJECTEURS.
PROYECTORES.
ПРОЖЕКТОРЫ.

BRITISH THOMSON-HOUSTON CO., LTD
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
PARSONS, C. A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS LTD.

SHADES, see "Fittings" and "Glassware."
ABAT-JOUR, voir "Accessoires" et "Verreries."
PANTALLAS, véase "Accesorios" y "Cristalería."
АБАЖУРЫ, см. ,,Принадлежности" и ,,Стеклянная Посуда".

SHIP INSTALLATIONS, Electric.
INSTALLATIONS Electriques pour **NAVIRES.**
INSTALACIONES Eléctricas para **BUQUES.**
СУДОВЫЯ Электрическія ОБОРУДОВАНІЯ.

ALLEN, W. H., SON & CO., LTD
BOOTHROYD, H T. LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO, LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
GENERAL ELECTRIC CO., LTD
HOWDEN JAMES & CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PARSONS, C. A., & CO.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO. LTD.
VICKERS, LTD.

Ships' Telegraph.
Télégraphes de Navires.
Telégrafos para Buques.
Судовые Телеграфы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
ELLIOTT BROTHERS.
EVERSHED & VIGNOLES, LTD.
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. & CO., LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.

Shipyard Cranes and Winches.
Grues et Treuils pour Chantiers de Construction Navale.
Grúas y Tornos para Astilleros.
Краны и Лебедки для Верфей.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.

SIGNALLING for RAILWAYS, Electrically operated.
SIGNALISATION Electriques pour **CHEMINS de FER.**
SEÑALES Eléctricos para **FERROCARRILES.**
ЖЕЛѢЗНОДОРОЖНАЯ СИГНАЛИЗАЦІЯ, Электр.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS & CO., LTD.

SIGNALS, Fire Alarms, etc.

SIGNAUX, Avertisseurs d'Incendie, etc.

SEÑALES, Alarmas de Incendio, etc.

СИГНАЛЫ, Пожарные и др.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

SIGNS, Electrically Illuminated.

RECLAMES Lumineuses Electriques.

RECLAMOS Luminosos Eléctricos.

ВЫВѢСКИ Электрическіе.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

STARTERS and STARTING PANELS, see "Control Gear."

DEMARREURS et TABLEAUX de DEMARRAGE, voir "Appareils Contrôleurs."

APARATOS y CUADROS de ARRANQUE, véase "Aparatos de Comprobación."

ПУСКОВЫЕ РЕОСТАТЫ и ДОСКИ, см. „Контрольные Аппараты".

STEAM ENGINES and STEAM TURBINES, see "Prime Movers."

MACHINES et TURBINES à VAPEUR, voir "Machines Motrices."

MAQUINAS y TURBINAS de VAPOR, véase "Máquinas-Motoras."

ПАРОВЫЯ МАШИНЫ и ТУРБИНЫ, см. „Двигатели".

STORAGE, Electrical, see "Accumulators."

ACCUMULAGE d'Electricité, voir "Accumulateurs."

ALMACENAJE de Electricidad, véase "Acumuladores."

АККУМУЛЯЦІЯ Электричества, см. „Аккумуляторы".

SWITCHES, see "Accessories" and "Switchgear."

INTERRUPTEURS, voir "Accessoires" et "Appareils de Distribution."

INTERRUPTORES, véase "Accesorios" y "Aparatos de Distribución."

ВЫКЛЮЧАТЕЛИ, см. „Принадлежности" и „Распредѣлительныя Устройства".

SWITCHGEAR, SWITCHES and SWITCHBOARDS for Mining, Industrial and General Power Purposes.

APPAREILS de DISTRIBUTION, INTERRUPTEURS et TABLEAUX de DISTRIBUTION pour Mines, Usines et Centrales.

APARATOS de DISTRIBUCION, INTERRUPTORES y CUADROS de DISTRIBUCION para Minas, Fábricas y Centrales.

РАСПРЕДѢЛИТЕЛЬНЫЯ УСТРОЙСТВА и ДОСКИ для Рудниковъ, Промышленныхъ и общихъ Цѣлей.

BERRY, SKINNER & CO.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
BROOK, HIRST & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC CONTROL, LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
MORRIS & LISTER, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
VENNER & CO. (Time Switches).
WESTMINSTER ENGINEERING CO., LTD
WHIPP & BOURNE.

Accumulator Switches (Battery Regulating Switches).

Réducteurs d'Accumulateurs (Réducteurs de Batterie).

Reductores de Acumuladores (Reductores de Batería).

Аккумуляторные Коммутаторы (Элементные Коммутаторы).

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.

WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

Circuit Breakers.
Interrupteurs à Levier.
Interruptores de Palanca.
Рычажные Выключатели.

BERRY, SKINNER & CO.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD
BROOK, HIRST & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELLISON, GEORGE, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MORRIS & LISTER, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Knife Switches.
Interrupteurs à Couteau.
Interruptores de Cuchillo.
Рубильники.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

TELEGRAPH APPARATUS.
APPAREILS TELEGRAPHIQUES.
APARATOS TELEGRAFICOS.
ТЕЛЕГРАФНЫЕ АППАРАТЫ.

ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS., & CO., LTD.

Telegraphy, Wireless, see "Wireless Telegraphy."
Télégraphie sans Fil, voir "Radio-Télégraphie."
Telegrafía sin Alambres, véase "Radio-Telegrafía."
Безпроволочный Телеграфъ, см. ,,Радіо-Телегр. Аппараты".

TELEPHONES.
TELEPHONES.
TELEFONOS.
ТЕЛЕФОНЫ.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Automatic Telephones.
Téléphones Automatiques.
Teléfonos Automáticos.
Автоматическіе Телефоны.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. & CO, LTD.

TELEPHONE SWITCHBOARDS.
TABLEAU COMMUTATEURS pour TELEPHONES.
CUADROS CONMUTADORES para TELEFONOS.
ТЕЛЕФОННЫЕ КОММУТАТОРЫ.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
SIEMENS BROS. & CO., LTD.

TERMINALS, see "Accessories."
BORNES, voir "Accessoires."
BORNAS, véase "Accesorios."
ЗАЖИМЫ, см. ,,Принадлежности".

TESTING SETS, see also "Instruments."
APPAREILS de LABORATOIRE, voir aussi "Instruments."
APARATOS de LABORATORIO, véase también "Instrumentos."
ПРИБОРЫ для ИСПЫТАНІЯ, см. также ,,Инструменты".

BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. & CO., LTD.

TEXTILE MOTORS and EQUIPMENT.

MOTEURS et ACCESSOIRES pour l'INDUSTRIE TEXTILE.

MOTORES y ACCESORIOS para la INDUSTRIA TEXTIL.

МОТОРЫ и ОБОРУДОВАНІЯ въ ТЕКСТИЛЬНОЙ ПРОМЫШЛЕННОСТИ.

BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
WILSON-WOLF ENGINEERING CO., LTD.

THEATRE LIGHTING.

ECLAIRAGE de THEATRES.

ALUMBRADO de TEATROS.

ОСВѢЩЕНІЕ ТЕАТРОВЪ.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROTHERS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

TRACTION APPLIANCES.

MATERIEL de TRACTION.

MATERIAL de TRACCION.

ПОДВИЖНЫЕ СОСТАВЫ.

Bonds.

Eclisses.

Juntas.

Стыки.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
GLOVER, W. T., & CO., LTD.

Brakes.

Freins.

Frenos.

Тормаза.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
COLE, MARCHENT & MORLEY, LTD.

Car Bodies.

Carrosserie.

Carroceria.

Вагонные Кузовы.

BRUSH ELECTRICAL ENGINEERING CO., LTD.

Gears.

Engrenages.

Engranajes.

Приводы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
VICKERS, LTD

Locomotives.

Locomotives.

Locomotoras.

Локомотивы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.

Motors.

Moteurs.

Motores.

Моторы.

BOOTHROYD, H T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Controllers, see "Control Gear."
Contrôleurs, voir "Appareils Contrôleurs."
Controleres, véase "Aparatos de Comprobación."
Контролеры, см. „Контрольные Аппараты."

Line Insulators, see "Insulators."
Isolateurs pour Lignes Aériennes, voir "Isolateurs."
Aisladores para Lineas Aéreas, véase "Aisladores."
Изоляторы для Трамвайныхъ Воздушныхъ Проводовъ, см. „Изоляторы".

Overhead Lines, see "Transmission."
Lignes Aériennes, voir "Transport d'Energie."
Lineas Aéreas, véase "Transmisión de Energía."
Воздушныя Проводки, см. „Передача Силы".

TRANSFORMERS for Power and Lighting.

TRANSFORMATEURS pour Force Motrice et Eclairage.

TRANSFORMADORES para Fuerza Motriz y Alumbrado

ТРАНСФОРМАТОРЫ для Силы и Освѣщенія.

BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FERRANTI, LTD.
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Transformers for Instruments, see "Instruments."
Transformateurs pour Instruments, voir "Instruments."
Transformadores para Instrumentos, véase "Instrumentos."
Трансформаторы для Инструментовъ см. ,,Инструменты".

TRANSMISSION LINES.
LIGNES pour le TRANSPORT d'ENERGIE.
LINEAS para la TRANSMISION de ENERGIA.
ЛИНІИ для ПЕРЕДАЧИ СИЛЫ.

Poles.
Poteaux.
Postes.
Столбы.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD
JOHNSON & PHILLIPS, LTD
SANDYCROFT, LTD.
SIEMENS BROS. & CO., LTD.

Overhead Lines, Aluminium.
Lignes Aériennes en Aluminium.
Lineas Aéreas de Aluminio.
Алюминіевыя Воздушныя Линіи.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SANDYCROFT, LTD.

Overhead Lines, Copper.
Lignes Aériennes en Cuivre.
Lineas Aéreas de Cobre.
Мѣдныя Воздушныя Линіи.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. & CO., LTD.

Insulators for Transmission Lines, see "Insulators."
Isolateurs pour Lignes de Transport d'Energie, voir "Isolateurs."
Aisladores para Lineas de Transporte de Energia, véase "Aisladores."
Изоляторы для Воздушныхъ Линій, см. ,,Изоляторы".

TUBING, see "Conduit."
TUBES, voir "Tubes Isolants."
TUBOS, véase "Tubos Aisladores."
ТРУБКИ, см. ,,Изоляціонныя Трубки"

xxi. D

TURBINES, Steam and Water, see "Prime Movers."
TURBINES à Vapeur et Hydrauliques, voir "Machine Motrices."
TURBINAS de Vapor y Hidráulicas, véase "Máquinas-Motoras."
ТУРБИНЫ, Паровыя и Водяныя, см. ,,Двигатели".

VENTILATING FANS, see "Fans."
VENTILATEURS EXTRACTEURS, voir "Ventilateurs."
VENTILADORES EXTRACTORES, véase "Ventiladores."
ВЫТЯЖНЫЕ ВЕНТИЛЯТОРЫ, см. ,,Вентиляторы".

WATER COOLING TOWERS.
TOURS REFRIGERANTES A EAU.
TORRES REFRIGERANTES POR AGUA.
ГРАДИРНИ.
PREMIER COOLER & ENGINEERING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WORTHINGTON PUMP CO., LTD.

WELDING, Electric, Appliances.
Appareils de **SOUDURE** Electrique.
Aparatos de **SOLDADURA** Eléctrica.
Аппараты для Электр. **СВАРКИ.**
CROMPTON & CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

WINCHES, see "Arc Lamps" and "Ship Installations."
TREUILS de LEVAGE, voir "Lampes à Arc" et "Installations pour Navires."
TORNOS de ELEVACION, véase "Lámparas de Arco" y "Instalaciones para Buques."
ЛЕБЕДКИ, см. ,,Дуговыя Лампы" и ,,Судовыя Оборудованія".

WIRELESS TELEGRAPHY APPLIANCES.
APPAREILS RADIO-TELEGRAPHIQUES.
APARATOS RADIO-TELEGRAFICOS.
РАДІО-ТЕЛЕГРАФНЫЕ АППАРАТЫ.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
SIEMENS BROS. & CO., LTD.

WIRES, see also "Cables."
FILS, voir aussi "Cables."
ALAMBRES, véase también "Cables."
ПРОВОДА, см. также ,,Кабели"
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

INDEX FRANÇAIS.

avec la traduction en anglais des en-tête sous lesquels est arrangé alphabétiquement l'Index Général en quatre langues, voir pages i. D—xxi. D.

Index Francais.

Index Francais.

ÍNDICE ESPAÑOL

con la traducción en inglés de los títulos, bajo les cuales se ha arreglado alfabéticamente el Indice General en cuatro idiomas, véase páginas i. D—xxi. D.

Índice Español.

РУССКІЙ УКАЗАТЕЛЬ

съ переводомъ на англійскій языкъ, по алфавиту котораго составленъ Общій Указатель на четырехъ языкахъ, см. стран. i. D—xxi. D.

По-Русски.	По-Англійски.
Конденсаторы, Электрическіе	**Condensers, Electrical**
Консольные Вентиляторы	**Bracket Fans**
Контачныя Штепселя и Коробки	**Plugs and Sockets**
Подъ " Accessories."	
Контрольные Аппараты	**Control Gear**
Контролеры для Крановыхъ Моторовъ	**Controllers for Crane Motors**
Подъ " Control Gear."	
Контролеры для Трамвайныхъ Моторовъ	**Controllers for Traction Work**
Подъ " Control Gear."	
Коробки (Отвѣтв.)	**Junction Boxes**
Коробки для Штепселей	**Sockets for Plugs**
Подъ " Accessories."	
Котельная Арматура	**Boiler Equipment**
Котлы	**Boilers**
Краны и Лебедки для Верфей	**Shipyard Cranes and Winches**
Подъ " Ship Installations."	
Крановые Моторы	**Crane Motors**
Кронштейны	**Brackets**
Подъ " Fittings."	
Лампы	**Lamps**
Лампы Накаливанія	**Incandescent Lamps**
Лампы для Радіаторовъ	**Radiator Lamps**
Лебедки для Дуговыхъ Лампъ	**Arc Lamp Winches**
Подъ " Arc Lamps."	
Легко-Плавкія Вставки	**Fuses**
Лифты (Электрическіе)	**Lifts, Electric**
Лифтовые Моторы	**Lift Motors**
Локомотивы	**Locomotives**
Подъ " Traction Appliances."	
Люстры	**Electroliers**
Подъ " Fittings."	
Магнеты	**Magnets**
Магнета	**Magnetos**
Магнитные Тормаза	**Brakes (Magnetic)**
Матеріялъ для Уличнаго Освѣщенія	**Street Fittings**
Подъ " Fittings."	
Мокрые Элементы	**Wet Cells**
Подъ " Batteries."	
Моторы Дызелъ	**Diesel Motors**
Подъ " Prime Movers."	
Моторы въ Текстильной Пролышлен.	**Textile Motors**
Моторы для Перем. и Пост. Тока	**Motors for A.C. and D.C.**
Нагрѣвательные Приборы	**Heating Appliances**
Насосы	**Pumps**
Настольные Вентиляторы	**Table Fans**
Подъ " Prime Movers."	
Новости для Рекламныхъ Цѣлей	**Novelties, Advertising**
Освѣщеніе Театровъ	**Theatre Lighting**
Отвѣтвительныя Коробки	**Junction Boxes**
Паровыя Турбины	**Steam Turbines**
Патроны	**Lampholders**
Подъ " Accessories."	
Переносные Сверлильные Станки	**Portable Drilling Machines**
Переносныя Лампы	**Standard Lamps**
Подъ " Fittings."	
Пирометры	**Pyrometers**
Плунжерные Насосы	**Pumps, Plunger**
Повысители Напряженія	**Boosters**
Подвижные Составы	**Traction Appliances**
Подводные Кабели	**Submarine Cables**
Подъ " Cables."	
Подвѣсные Изоляторы	**Suspension Insulators**
Подъ " Insulators."	
Подвѣсныя Лампы	**Pendants**
Подъ " Fittings."	
Подъемники (Электр.)	**Hoists, Electric**
Пожарные Сигналы	**Fire Alarms**
Подъ " Signals."	
Поршневыя Паровыя Машины	**Reciprocating Steam Engines**
Подъ " Prime Movers."	
Постоянные Магниты	**Magnets, Permanent**
Потолочные Вентиляторы	**Ceiling Fans**
Подъ " Fans."	
Потолочныя Гарнитуры	**Ceiling Fittings**
Подъ " Fittings."	
Потолочныя Розетки	**Ceiling Roses**
Подъ " Accessories."	
Предохранители	**Cut-Outs**
Преобразователи	**Rotary Converters**
Прессованные Картоны	**Press Spahn**
Подъ " Insulating Material."	
Приборы для Испытанія	**Testing Sets**
Приборы для Рентгеновскихъ Лучей	**X-Ray Outfits**
Принадлежности	**Accessories**
Принадлежности для Электр. Свѣта	**Fittings for Electric Light**
Провода	**Wires**
Проводки для Передачи Силы	**Transmission Lines**
Проводовыя Рейки	**Casing and Capping**
Подъ " Accessories."	
Противовѣсы	**Counterweights**
Подъ " Fittings."	
Пусковые Аппараты и Доски для Моторовъ	**Starters and Starting Panel**
Пылесосы	**Vacuum Cleaners**
Подъ " Domestic Appliances."	
Радіаторы	**Radiators**
Радіаторы (Безсвѣтные)	**Radiators, Non-Luminous**
Радіо-Телеграфные Аппараты	**Wireless Telegraphy Appliances**
Распредѣлительныя Доски	**Distribution Boards**
Распредѣлительныя Устройства	**Switchgear**
Растяжимыя Соединенія	**Expansion Joints**
Подъ " Cables."	
Рейки для Проводовъ	**Casing and Capping**
Подъ " Accessories."	
Реле	**Relays**
Реостаты	**Rheostats**

INDEX TO COMPANIES IN CLASSIFIED DIRECTORY

NAME.	Head Offices or Works.	Telegraphic Address	Codes Used
*ALLEN WEST & CO. LTD.	Lewes Road, Brighton	Control, Brighton	5th Edition, A.B.C.
ALLEN, W. H., SON & CO., LTD.	Queen's Engineering Works, Bedford	Pump, Bedford	A.B.C. 5th Edition, A1 Engineering, Broomhall Imperial Atom, Western Union and Private.
ALLEY & MACLELLAN, LTD.	Sentinel Works, Polmadie, Glasgow	Alley, Glasgow	A.B.C. 5th Edition, Engineering Telegraph, Western Union.
*ARON ELECTRICITY METER, LTD.	80A, Salusbury Road, Kilburn, London, N.W.	Arronzar, London	A B C 4th and 5th Editions.
ASHWORTH & PARKER	Bury, Lancs.	Kinetic	Western Union, A.B.C. 5th Edition
*BELLISS & MORCOM, LTD.	Ledsam Street Works, Birmingham	Belliss, Birmingham	A.B.C. 5th Edition, Engineering 2nd Edition, Western Union (Universal Edition), Lieber's.
*BERRY, SKINNER & CO.	78, Upper Thames Street, London, E.C.	Ptolemaist	A B C Code 4th and 5th Editions
„ „ „	Suffolk Works, Oozells Street, Birmingham	„	Western Union, Universal Edition.
*BOOTHROYD H. T. LTD	Bootle, Liverpool	Commutator, Liverpool.	———
BRAY, MARKHAM & REISS, LTD.	Blackhorse Lane, Walthamstow, N.E.	Bramaria, Walthill, London	———
*BRITISH ELECTRIC PLANT CO., LTD.	78 St. Vincent Street, Glasgow	Bepco, Glasgow	A.B.C. 5th Edition.
*BRITISH ELECTRIC TRANSFORMER CO., LTD	Hayes, Middlesex, and 48, Oxford Street, London, W.	Transfundo, Hayes, Middlesex	A.B C. 5th Edition, Western Union Engineering, 2nd Edition.
*BRITISH THOMSON-HOUSTON CO., LTD	Rugby England	Asteroidal Rugby; Solutrix, London	Lieber, A.B.C. and Western Union
„ „ „ „	Mazda House, 77, Upper Thames Street, E.C.	Mazdalux, Cannon, London	Lieber's A B C
*BRITISH WESTINGHOUSE ELECTRIC & M'F'G. CO., LTD.	Trafford Park, Manchester	Westinghouse, Manchester	A.B.C. 5th Edition, Western Union Lieber's.
*BROOK, HIRST & CO., LTD.	Northgate Electrical Works, Chester	Switches, Chester	A.B.C. 5th Edition.
BROTHERHOOD, PETER, LTD.	Peterborough	Brotherhood, Peterborough. Brotherhood, Parl, London.	A.B.C. 5th Edition.
*BROWETT, LINDLEY & CO., LTD.	Patricroft, Manchester	Sandon, Patricroft	Lieber's, A.B.C. 5th Edition, Engineering.
*BRUSH ELECTRICAL ENGINEERING CO., LTD.	Falcon Works, Loughborough, Leicestershire	Falcon, Loughborough.	A.B C. 5th Edition, A1, Western Union, Engineering.
„ „ „ „	LONDON OFFICE:—1, Kingsway, London, W.C	Magneto, London.	„ „ „
*CALLENDER'S CABLE & CONSTRUCTION CO., LTD.	Hamilton House, Victoria Embankment, London, E.C.	Callender, Fleet, London	———
CHAMBERLAIN & HOOKHAM, LTD.	Solar Works, Birmingham	Solar, Birmingham	ABC. 5th Edition, Western Union
*CLARKE, CHAPMAN & CO., LTD.	Gateshead-on-Tyne	Cyclops, Gateshead	A.B.C. 4th and 5th Editions, A1, Engineering 1st and 2nd Editions, Lieber's, Broomhall's, Moreing and Neil's, Watkins, Western Union and Private.
*COLE, MARCHENT & MORLEY, LTD.	Wakefield Road, Bradford, England	Cole, Bradford	A1, A.B.C. 5th Edition, Engineering 1st and 2nd Editions, Western Union, Lieber's.
CREDENDA CONDUITS CO., LTD.	Chester Street, Aston, Birmingham	Credenda, Birmingham	———
*CROMPTON & CO., LTD.	Salisbury House, London Wall, E.C.	Crompton, Ave, London	Bentley, A.B.C. 5th Edition, Lieber's.
DAY, ST. JOHN, (PATENTS), LTD.	Bank Mills, Morton Street, Oldham	Day, 305 Oldham	A.B.C. 5th Edition.
*DICK, KERR & CO., LTD.	Abchurch Yard, Cannon Street, E.C.	Dicker, London	Bentley, Western Union, Lieber's, A.B.C. 5th Edition
D-P. BATTERY CO., LTD.	Lumford Mills, Bakewell, Derbyshire, and 11, Victoria St., Westminster, S W.	Battery, Bakewell; Cumulose, London.	A.B.C. 5th Edition, New Business, Private.
*ECKSTEIN, HEAP & CO., LTD.	Lancashire Switchgear Works, Broughton, Manchester	Electron	———
*EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.	Ponders End Middlesex	Ediswan, Ponders End.	———
ELECTRICAL APPARATUS CO., LTD.	Vauxhall Works, South Lambeth Road, London, S.W.	Elapratus, London	A.B.C. 5th Edition
*ELECTRICAL ENGINEERING AND EQUIPMENT CO., LTD.	Bank Buildings, 109–11, New Oxford Street, London, W.C.	Thermotype, Westcent, London	A.B.C. 5th Edition.
*ELECTRIC CONTROL LTD.	177, Reid Street, Glasgow, and	Control, Glasgow	———
	Queen Anne's Chambers, Westminster, S.W.	Autoswitch, Vic, London	A.B.C. 5th Edition.
*ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.	Cheston Road, Aston, Birmingham	E.O.A. Birmingham	A B.C. 5th Edition.

NAME.	Head Offices or Works.	Telegraphic Address.	Codes Used.
*ELECTROMOTORS, LTD.	Openshaw, Manchester	Magnet, Manchester	A B.C. 5th Edition.
*ELLIOTT BROTHERS	1, Central Buildings, Westminster, S.W.	Elliottize, London	A.B.C. 5th Edition.
ELLISON, GEORGE	Victoria Works, Warstone Lane, Birmingham	Induction, Birmingham	Western Union, Lieber's and Engineering.
*EVERETT, EDGCUMBE & CO., LTD.	117, Victoria Street, S W.	Everectus	A.B.C. 5th Edition
" " " " "	FACTORY :—Collindale Works, Hendon, N.W.	———	———
*EVERSHED & VIGNOLES LTD.	Acton Lane Works, Chiswick, London, W.	Dorothea, London	A B C. 5th Edition, Western Union (Universal Edition), Eng. 2nd Ed
*FERRANTI, LTD.	Central House, Kingsway, London, W.C	Ferranti, Westcent, London; Cables—Ferranti, London	A.B.C. 4th and 5th Editions, A1, Cole, Engineering, Lieber's, Western Union.
" "	WORKS :—Hollinwood, near Manchester	———	" " "
*FRASER & CHALMERS, LTD.	Erith, Kent	Vanner, Erith	A.B.C. 4th and 5th Editions, Moreing and Neal, Broomhalls, Imperial, Western Union.
*GENERAL ELECTRIC CO. LTD.	67, Queen Victoria Street, London, E.C.	Electricity Cables, Polyphase	A.B.C Lieber's, Western Union.
GLOVER, W. T., & CO., LTD.	Trafford Park, Manchester	Cables, Manchester	A.B.C. 5th Edition, Lieber's, Western Union and Private Code.
*GREENWOOD & BATLEY, LTD	Albion Works, Armley Road, Leeds	Greenwood, Leeds	A.B.C. 4th and 5th Editions, Lieber's, Engineering 1st and 2nd Editions, A1 Western Union and Bentley's.
*HENLEY'S, W. T., TELEGRAPH WORKS, LTD	Blomfield Street London, E.C.	Inland, Henletel Ave, London; Cables—Henleys, London	Western Union, A.B.C., 5th Edition Lieber's and Private.
*HICK HARGREAVES & CO., LTD.	Soho Iron Works, Bolton	Hick, Bolton	A.B.C 5th Edition, A1 (1888), Western Union, Lieber's Standard.
*HOWDEN, JAMES & CO., LTD.	195, Scotland Street, Glasgow	Howden, Glasgow	A.B.C. 5th Edition, Western Union.
*IGRANIC ELECTRIC CO., LTD.	147, Queen Victoria Street, London, E.C.	Igranic	Lieber's and Private.
" "	WORK:—Bedford, England	———	———
*JANDUS ARC LAMP & ELECTRIC CO., LTD.	Hartham Road, Holloway, London, N.	Jandunus, Holway, London	A.B.C. 5th Edition.
*JOHNSON & PHILLIPS, LTD.	Victoria Works, Charlton, London, S.E.	Juno Charlton, Kent	A.B.C., 5th Edition, A1, 5th Edition, Engineering, Lieber's, Western Union.
*LANCASHIRE DYNAMO & MOTOR CO., LTD.	Trafford Park, Manchester	Ironclad, Manchester	A.B.C. 5th Edition, Western Union, Engineering, Cole's
LIVERPOOL ELECTRIC CABLE CO., LTD.	Linacre Lane, Bootle, Liverpool	Concentric, Liverpool	A.B.C. 5th Edition.
LUCY & CO, W., LTD.	Eagle Ironworks, Oxford	Lucy, Oxford	———
*LUNDBERG, A. P., & SONS	477-489, Liverpool Road, London, N	Lundberg, London	A.B.C 5th Edition.
*MATHER & PLATT, LTD	Park Works, Newton Heath, Manchester	Mather or Sprinkler, Manchester	Western Union, Universal Edition, Lieber's, A B.C. 4th and 5th Editions, A1, M. & P. Private.
*MAVOR & COULSON, LTD.	47, Broad Street, Mile End, Glasgow	Prodigious, Glasgow	A.B.C. 5th Edition, Engineering 2nd Edition, Bentley's.
*MAWDSLEY'S, LTD.	Zone Works, Dursley, Glos.	Zone, Dursley	A.B.C. 5th Edition.
*MIRRLEES WATSON CO., LTD.	45, Scotland Street, Glasgow, and 122, Cannon Street, London, E.C.	Mirrlees, Glasgow; Mirrlees, Cannon, London	Western Union, Lieber's, Engineering, A.B.C and A1.
*MORGAN CRUCIBLE CO., LTD	Battersea Works, London, S.W.	Crucible, Battsquare, London (two words chargeable)	A.B.C. 4th and 5th Editions A1, Lieber's and Western Union (Universal Edition).
MORRIS & LISTER, LTD.	Carlton Works, Lockhurst Lane, Coventry	Carlton, Coventry	———
*NALDER BROS. & THOMPSON, LTD.	97a, Dalston Lane, London, N.E.	Occlude, Kinland, London	Western Union.
*OSRAM-ROBERTSON LAMP WORKS LTD	Brook Green, Hammersmith, London, W.	Electricity London. Cables—Polyphase	A.B.C., Lieber's, Western Union and Private.
*PARK ROYAL ENGINEERING WORKS, LTD.	Cumberland Avenue, Willesden, London, N.W.	Isobar, Harles, London.	A.B.C. 5th Edition.
*PARSONS, C. A., & CO., LTD.	Heaton Works, Newcastle-on-Tyne	Turbo, Newcastle-on-Tyne	A1, A.B C., Western Union.
" " "	LONDON OFFICE :—8, Victoria Street, London, S W.	Silently Vic, London	" " "
*PAUL, ROBERT W.	Newton Avenue Works, New Southgate, N., and 1, East 42nd Street, New York, U.S.A.	Unipivot, London	———

NAME.	Head Offices and Works.	Telegraphic Address.	Codes Used.
*PEEBLES, BRUCE, & CO., LTD.	Edinburgh	Peebles, Edinburgh	Western Union, A.B.C., 5th Edition New Business and Private.
*PHŒNIX DYNAMO M'F'G. CO., LTD.	Thornbury Works, Bradford	Dynamo, Bradford	A.B.C. 5th Edition and Private.
PIRELLI, LTD.	144, Queen Victoria Street, London, E.C.	Pirellicon Cent, London	———
*PREMIER COOLER & ENGINEERING CO., LTD.	Broadway Court, Broadway, Westminster, S.W.	Precooler, Vic, London	Lieber's, A.B.C 5th Edition.
PRITCHETTS & GOLD & ELECTRICAL POWER STORAGE CO., LTD.	82, Victoria Street, London, S.W.	Acidulated, Sowest, London	Bentley's or A.B.C.5th Edition
REASON MANUFACTURING CO., LTD.	Lewes Road, Brighton	Reason, Brighton	A.B.C. 5th Edition.
*RECORD ELECTRICAL CO., LTD.	Caxton House, Westminster	Infusion, London	A.B.C. 5th Edition and Bentley's.
" " " "	WORKS.—Broadheath, Manchester	———	———
*REES ROTURBO MANUFACTURING CO., LTD.	Wolverhampton	Roturbo, Wolverhampton	Engineering 2nd Edition, A1 Western Union, A.B.C. 5th Edition.
*REYROLLE, A., & CO., LTD.	Hebburn-on-Tyne,?England	Reyrolle, Hebburn	A.B.C. 5th Edition, Western Union (Universal Edition) and New Business.
*RHODES MOTORS, LTD.	Riverside Works, Doncsater	Rhodique, Doncaster	A.B.C. 5th Edition and Private, Hamilton's Code Condenser.
*RICHARDSONS, WESTGARTH & CO., LTD.	Hartlepool	Richardsons, Hartlepool	A.B.C. 5th Edition, Western Union
SANDYCROFT LTD.	Sandycroft, near Chester	Sandycroft, Hawarden	———
SIEMENS BROS. & CO., LTD.	Telegraph Works, Woolwich	Siemens, Woolwich	A.B.C. 5th Edition, Lieber's, Western Union, Broomhall, Moreing and McCutcheon.
*SIEMENS BROS. DYNAMO WORKS, LTD.	Caxton House, Westminster, S.W.	Siembralos, Vic. London	Moreing and McCutcheon, Lieber's Western Union, A.B.C. 4th and 5th Editoins, A1 Engineering.
" " " " " "	38 & 39 Upper Thames Street, E.C.	Siemotor, Cent. London	" "
*SUN ELECTRICAL CO., LTD.	118-120, Charing Cross Road, London, W.C.	Secablis Ox, London	A.B.C. 5th Edition.
*SUNDERLAND FORGE & ENGINEERING CO., LTD.	Sunderland	Marr	———
*SWITCHGEAR & COWANS, LTD.	Springfield Lane, Salford, Manchester	Control, Manchester	Western Union, A.B.C. 4th Edition.
TUDOR ACCUMULATOR CO., LTD.	3, Central Buildings, Westminster, London, S.W.	Extudorex, London	A.B.C. 5th Editoin.
*VENNER & CO.	6, Old Queen Street, Westminster, London, S.W.	Trydan Vic., London	A.B.C. 5th Edition, Western Union, Marconi, Private.
*VICKERS, LTD.	Sheffield and London, Westminster, S.W.	Vickers, Sheffield	A.B.C. 5th Edition, Western Union.
WESTMINSTER ENGINEERING CO., LTD.	Victoria Road, Willesden Junction, N.W.	Regnecy, London	A.B.C. 5th Edition.
WHIPP & BOURNE	Castleton, Manchester	Switches, Castleton, Lancs.	A.B.C. and Lieber's.
*WILLANS & ROBINSON, LTD.	Victoria Works, Rugby	Willans, Rugby	A1, Lieber's, Cole, A.B.C. 4th and 5th Eds., Eng. 2nd Ed.
*WILSON-WOLF ENGINEERING CO., LTD.	Bradford	Energy	A.B.C. 5th Edition, and Private.
*WORTHINGTON PUMP COMPANY, LTD.	India House, Kingsway, W.C.	Pumping, Estrand, London	———

*WILSON-WOLF ENGINEERING CO., LTD.	Bradford	Energy	A.B.C. 5th Edition, and Private.
*WORTHINGTON PUMP COMPANY, LTD.	India House, Kingsway, W.C.	Pumping, Estrand, London	———

* See announcement in advertisement pages, which are arranged alphabetically.
* Voir les pages des annonces placées par ordre alphabétique.
* Véanse las páginas continiendo los anuncios en órden alfabético.
* Si vedano le pagine degli annunzi posti per ordine alfabetico.
* См. въ объявленіяхъ, расположенныхъ по алфавиту.

WHAT THEY SIGNIFY

The central heart of the British Empire is in these northern islands. As long as this heart beats life will flow through the arteries of the Empire and the pulsation will be felt in all those united countries on which the sun never sets.

The world needs the British Empire because, as it has grown, it has brought into realization the longings of men for Self-Government, Justice and Liberty. These ideals have been wrought out by centuries of endeavour in this country and have been carried around the world by the pioneers—the colonists and traders of the British race.

The export trade is necessary to maintain British standards of conduct among men ; for it nourishes the vital fluid in the arteries of the Empire.

British products mean a great deal more than the machinery, instruments, lamps, accessories, etc., that are announced and described in these pages. They signify the integrity of the people who inhabit these northern islands. They denote the thoroughness, reliability, honesty and *quid pro quo* qualities which have given this country its standing all over the globe.

These manufactures are advertised in order to carry on the export business of the country and not to under-sell the products of any other nation ; they are sent to all parts of the world and are bought by those who desire to secure reliable, first-class goods. Added to this sound business reason for purchasing British goods, there is another deeper reason why buyers now prefer them ; they wish to contribute to the continuance of the British Empire and to support Great Britain in this titanic war for Human Rights.

Printed for the Proprietors by Percy Lund, Humphries & Co., Ltd., The Country Press, Bradford.
and 3, Amen Corner, London, E.C.
25334

THE BEAMA JOURNAL

Vol. II No. 3 JULY 1916

CONTENIDO

(Contents of English Section, page 105)

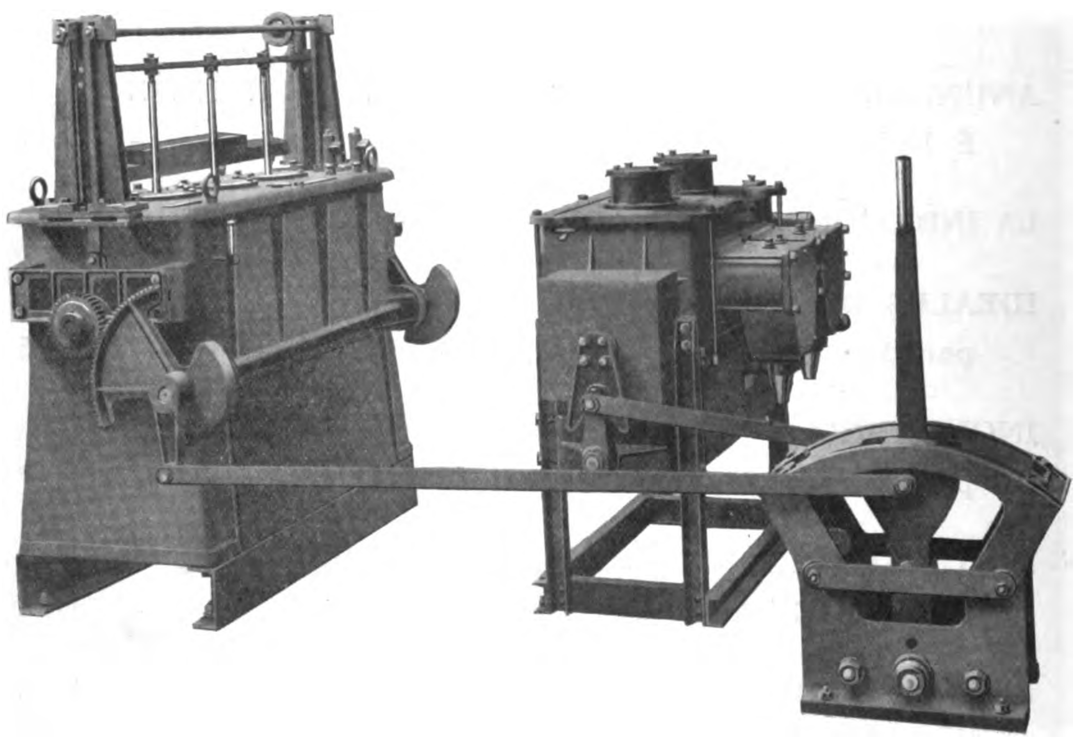
ALLEN WEST & Co., Ltd.

BRIGHTON

Telegrams: Control, Brighton.

Code: A.B.C., 5th Edition.

ELECTRIC CONTROLLERS

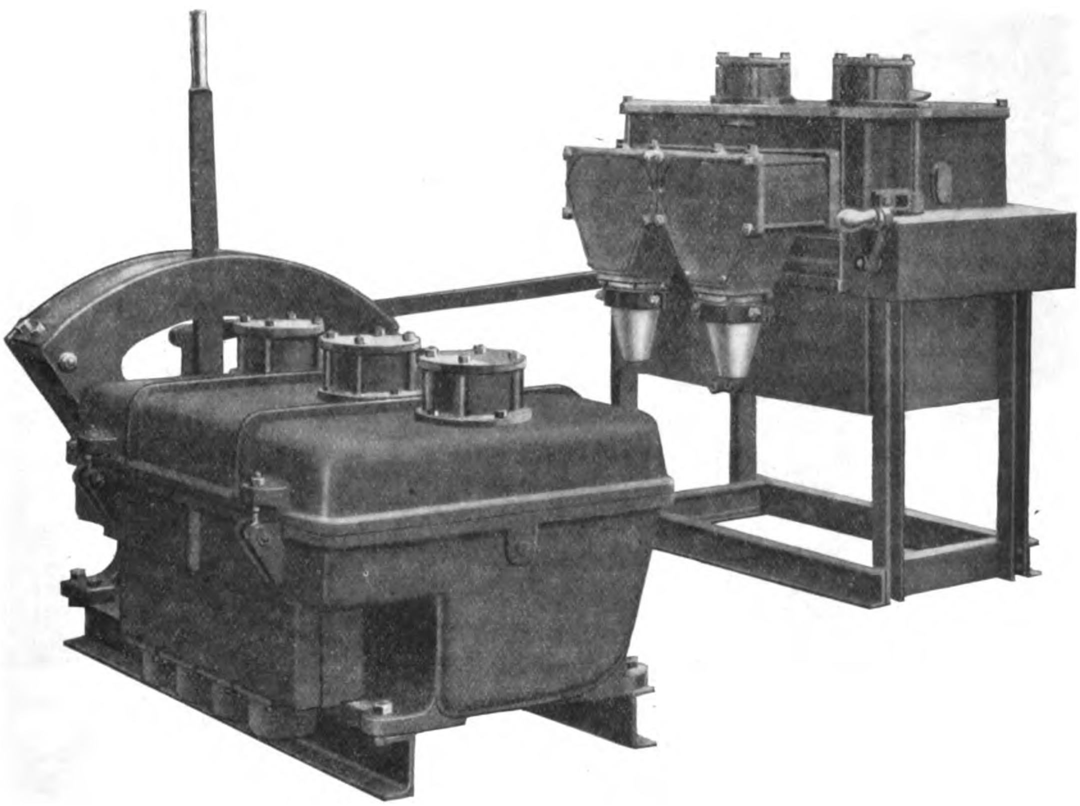


Registradores mineros, con reversores de contacto de alta tensión y acción rápida.

Um typo representativo de Controlladores mineiros, com Chaves reversiveis de alta tensão de rapida acção.

Type général de Combinateur pour exploit tions minières, avec inverseurs à contact et rupture brusque pour haute tension.

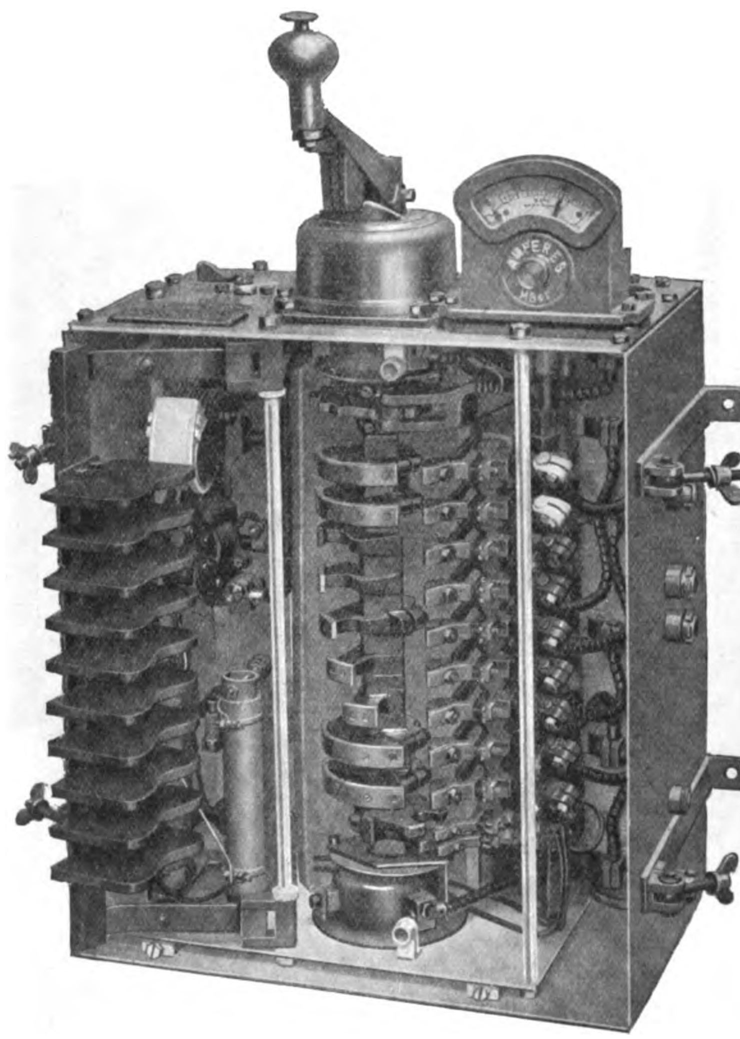
ELECTRIC CONTROLLERS



Otro Modelo.

Outro Typo do mesmo.

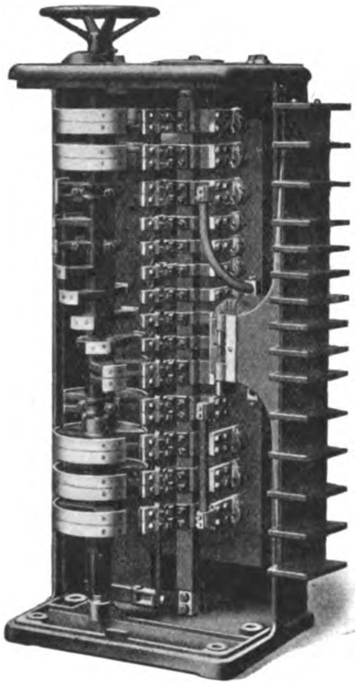
Un autre type.



Controlador impermeable, Modelo Almirantazgo, con desembrague de circuito "Contratista" y resistencia automática.

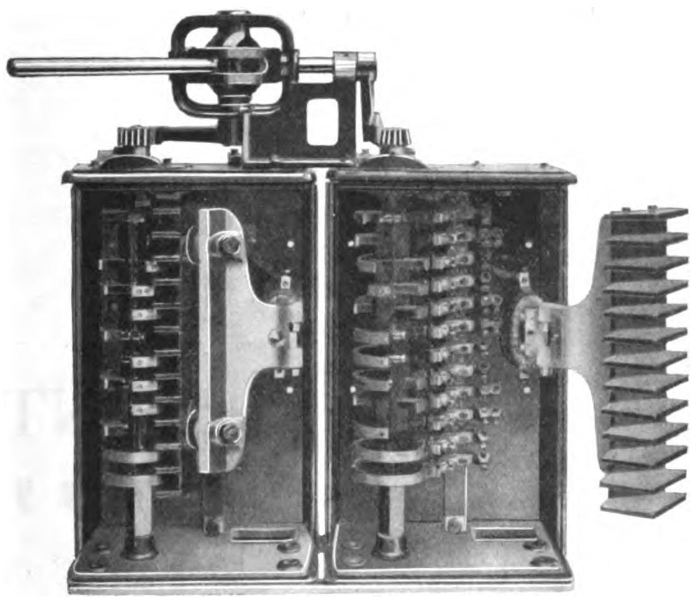
Typo do Almirantado de Controllador estanque com Fechador de circuito de typo Contractor e resistencia automatica.

Combinateur imperméable type de la Marine, avec résistance et disjoncteur type Entrepreneur formant tout complet.



Los dos grabados que publicamos en esta página ilustran dos modelos de Controladores de Tambor, fabricados por Allen West & Cía.

Estos controladores, como todos los que produce dicho Establecimiento, sedistinguen por su esmerada construcción y por la excelente calidad de los materiales empleados en ella. Júzguese, si no, por el hecho siguiente, uno de los muchos que podríamos citar : las clavijas de los controladores de Allen West & Cía., consisten en una pieza de bronce rojo de gran resistencia mecánica, colocada sobre un soporte macizo de la base, y ajustada al tambor por medio de un resorte poderoso.



Advertimos que tales clavijas han sido adoptadas por el Almirantazgo Inglés como tipo normal para la Marina.

La Casa Allen West & Cía., fabrica controladores de toda clase : para grúas, montacargas, minas, etc., en modelos corrientes, y tiene existencias permanentes.

Esta fábrica está única y exclusivamente dedicada a la construcción de Controladores, lo cual le permite atender a cualquier pedido pronta y económicamente.

ARON
CLOCK TYPE METER

FOR ALL PURPOSES C.C. & A.C.

CERTIFICATE
—OF—
EXAMINATION
OF
Watt-hour Meter No. 5042, № 29396.

Makers:	The Aron Electricity Meter, Ltd.
Type:	Oscillating pendulum. Unshunted.
Range:	1,000 amperes, 550 volts. Continuous Current.

The meter has been tested at various loads over a pressure range of from 500 to 550 volts.

Temperature Coefficient.

Tests were made with an external air temperature of both 18° C. and 31° C. From the results given below it will be seen that the two sets of readings are in close agreement, the difference between them being not greater than is found between two readings of the meter taken under exactly similar conditions. The temperature coefficient, therefore, is negligible for the normal range of temperature variation.

	Meter Error per Cent.	
Load.	At 31° C.	At 18° C.
Full	+0.3	+0.3
½	−0.1	−0.3
¼	−0.5	−0.6
$\frac{1}{10}$		−1.2

Date 18th May, 1916.
Reference E.T.D. 108. 89.

Director.

UNAFFECTED BY VOLTAGE VARIATION.

UNAFFECTED BY STRAY FIELDS.

Whole Current Type.

TEMPERATURE CO-EFFICIENT
"NEGLIGIBLE"

MANUFACTURED BY—

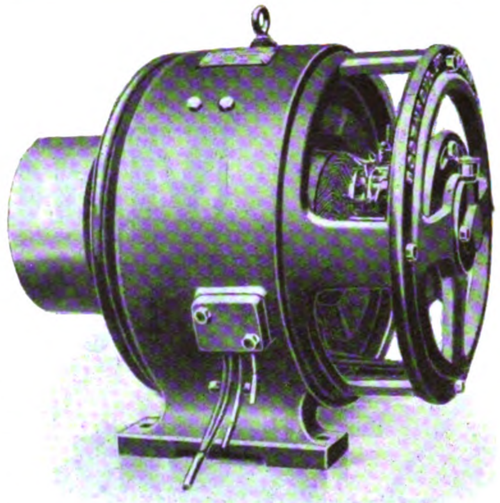
ARON ELECTRICITY METER, LTD.,

Head Offices and Works - - - - 80a, Salusbury Road, Kilburn, London, N.W.

v.

LOS DINAMOS Y MOTORES
DE NUESTRA MARCA
PRODUCEN RESULTADOS
OPIMOS DONDEQUIERA QUE
SE USEN.

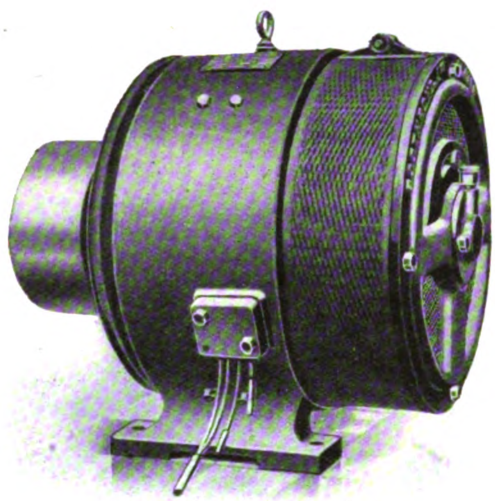
INFORMES COMPLETOS Y
PRECIOS GRATIS.



Modelo descubierto y protegido.

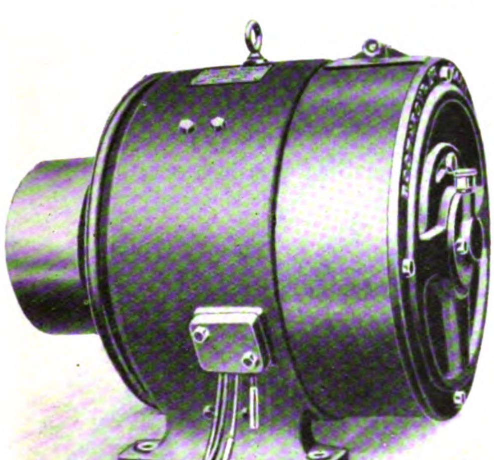
DINAMOS Y MOTORES
BOOTHROYD

Nuestros modelos reúnen todos los últimos perfecciona-mientos de la ciencia.



Modelo protegido y ventilado.

Estos grabados ilustran máquinas de nuestro modelo "B," provistas con cojinetes de bolas.

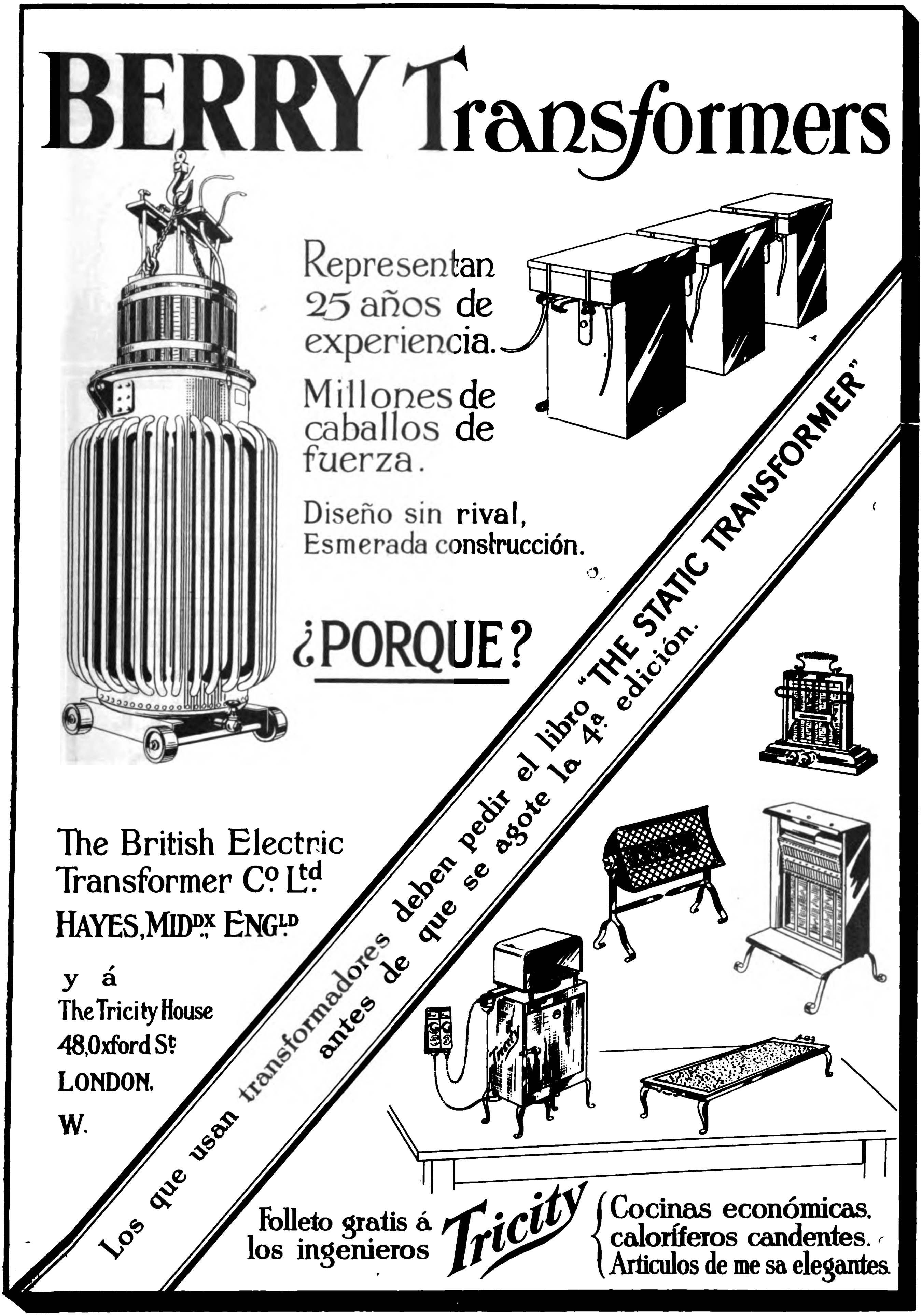


Modelo totalmente protegido.

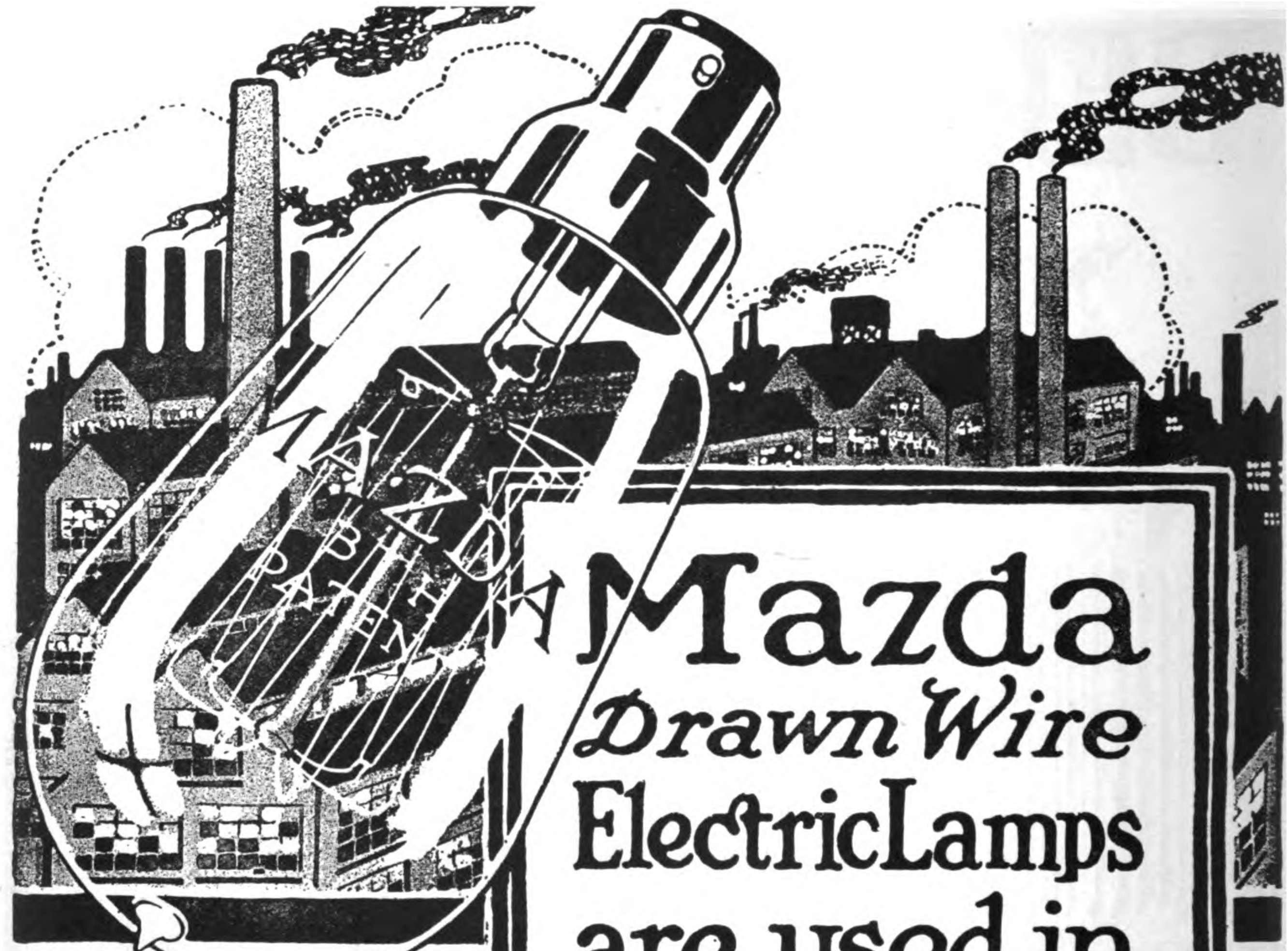
H. T. BOOTHROYD, LTD.,

BOOTLE, - LIVERPOOL.

Telegrams: "COMMUTATOR, LIVERPOOL."
Telephone: 420 BOOTLE.



BERRY Transformers
Representan 25 años de experiencia.
Millones de caballos de fuerza.
Diseño sin rival, Esmerada construcción.
¿PORQUE?
Los que usan transformadores deben pedir el libro "THE STATIC TRANSFORMER"
antes de que se agote la 4ª. edición.
The British Electric Transformer Cº Lᵗᵈ
HAYES, MIDᴰˣ ENGᴸᴰ
y á
The Tricity House
48, Oxford Sᵗ
LONDON,
W.
Folleto gratis á los ingenieros
Tricity
Cocinas económicas.
caloríferos candentes.
Articulos de me sa elegantes.



¿QUIERE UD. LUCHAR VENTAJOSAMENTE CONTRA SUS COMPETIDORES?

Los industriales que logran mayores triunfos en sus respectivas empresas son invariablemente los que tienen el feliz acierto de emplear las mejores máquinas, lo cual les permite fabricar artículos excelentes en corto tiempo, y así venderlos a precios relativamente bajos.

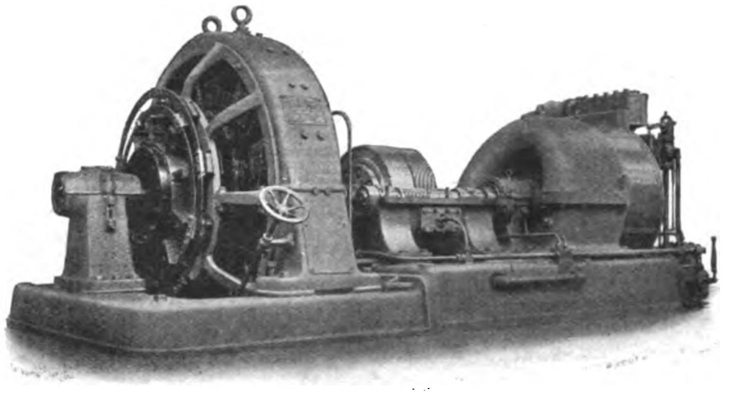
Nuestra dilatada experiencia nos ha demostrado que quienes solicitan presupuestos a varias casas con el objeto de favorecer a la que venda máquinas de más bajo precio, son hostiles a sus propios intereses, porque una máquina de $100, por ejemplo, dura notablemente menos que otra similar de $150, exige mayores desembolsos en reparaciones, y produce un trabajo que está muy lejos de igualarse al de esta última. Por otra parte, como los gastos de producción son más elevados, el artículo cuesta más al consumidor, sin ser por ello tan bueno como el que produce la máquina de calidad superior.

Por lo tanto, si quiere Ud. luchar ventajosamente contra sus competidores, ensanchar su campo de acción, y al propio tiempo fomentar el progreso de la industria, es obvio que debe anteponer la buena calidad al precio; en otros términos: no se diga Ud. jamás: "¿Es ésta la máquina más barata que puedo comprar?"; sino "¿Es ésta la mejor máquina que puedo adquirir?", y luégo "¿Es su precio razonable?".

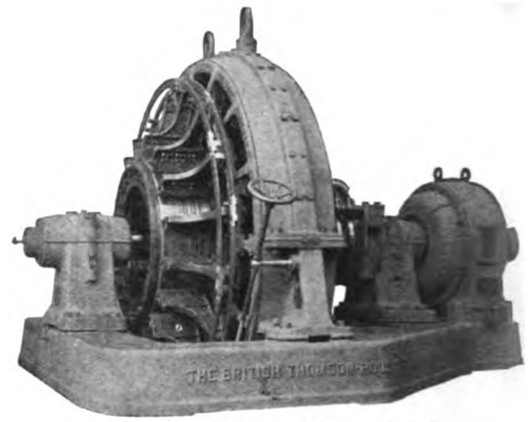
El lema de todo industrial inteligente ha de ser: Lo mejor es siempre barato; lo malo es siempre caro, a cualquier precio.

En el DIRECTORIO DE FABRICANTES ("Directory of Manufacturers") que insertamos en esta revista encontrará Ud. nombres de casas de confianza que venden artículos inmejorables, a precios equitativos. No vacile Ud. en dirigirse a ellas siempre que necesite algo en los ramos que allí se mencionan: será Ud. atendido con el mayor cuidado, y sus pedidos despachados en el menor tiempo posible. Es cierto que en algunos casos tendrá Ud. que aguardar un poco, debido a las condiciones creadas por esta malhadada guerra; pero hallará amplia compensación en la excelencia y relativa baratura de las mercancías que adquiera de nuestros socios.

TOME UD. NOTA DE LAS CASAS QUE LE INTERESEN, Y ESCRÍBALES EN SEGUIDA. GUANTO ANTES LO HAGA, TANTO MEJOR PARA USTED!



B.T.H. Geared Turbo-Generator.



B.T.H. Rotary Converter.

¶ Specify B.T.H. Electrical Apparatus for your electric lighting and power supply, and be assured of reliability and negligible maintenance costs.

The British Thomson

Head Office and Works:
Rugby, England

Electrical Engineers

Curtis Steam Turbines
A.C. and D.C. Turbo-Gens.
Alternators and D.C. Generators
A.C. and D.C. Motors
Rotary Converters

Blowers and Exhausters
Switchgear and Switches
Tramway and Railway Motors
Automatic Control Gear
Tirrill Regulators

Foreign Representatives:

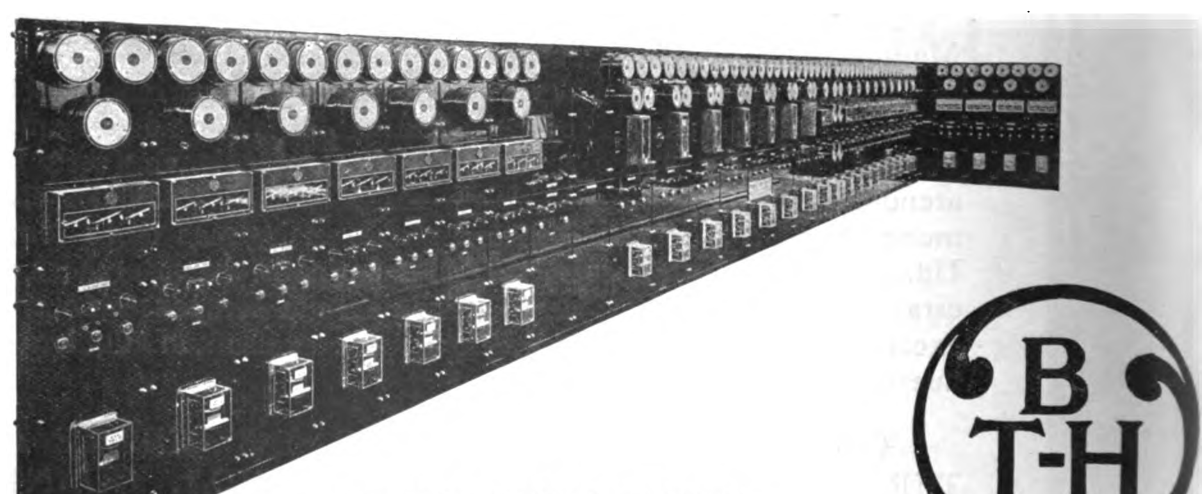
ARGENTINA.—Cia. General Electric Sudamericana Inc., Buenos Ayres.

AUSTRALIA.—Australian General Electric Co., Melbourne and Sydney; Unbehaun & Johnstone, Adelaide; Engineering Supply Co., Ltd., Brisbane; Chas. Atkins & Co., Ltd., Perth.

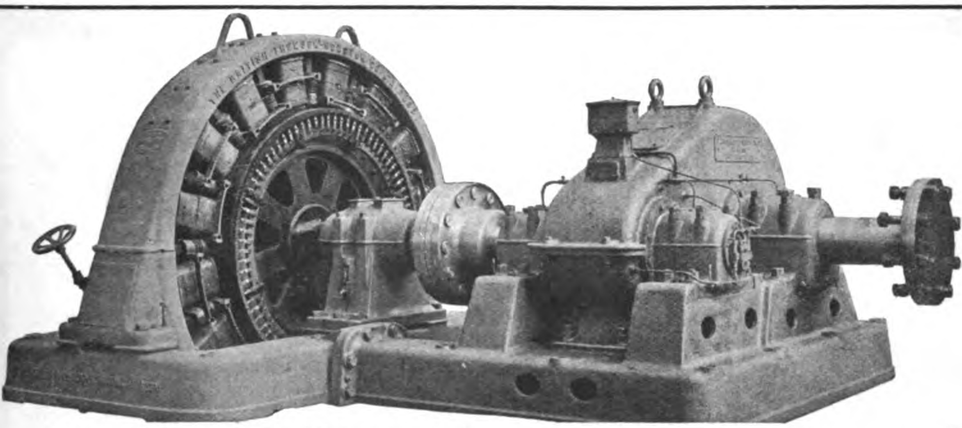
BRAZIL.—Cia. General Electric do Brazil, Rio de Janeiro and Sao Paulo.

CHILI.—The International Machinery Co., Santiago.

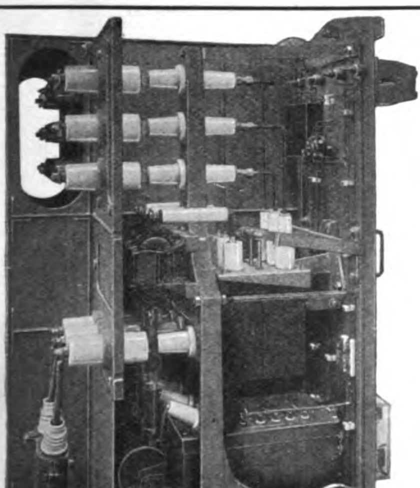
CHINA.—Andersen, Meyer & Co., Ltd., Shanghai.



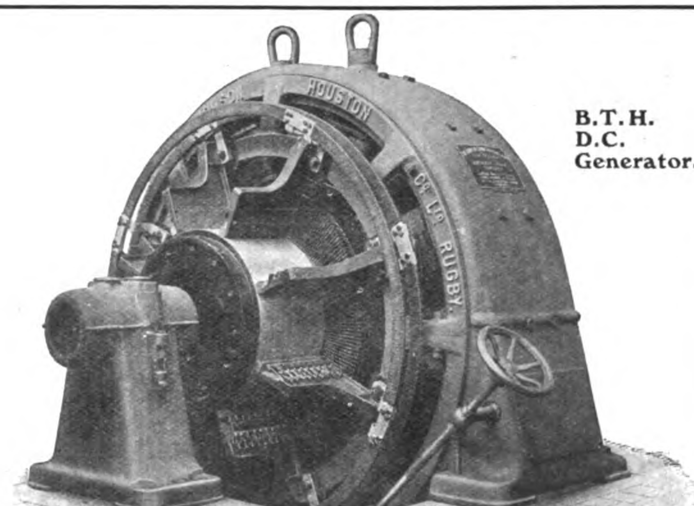
Generating Station Control Board,
3300 volts.



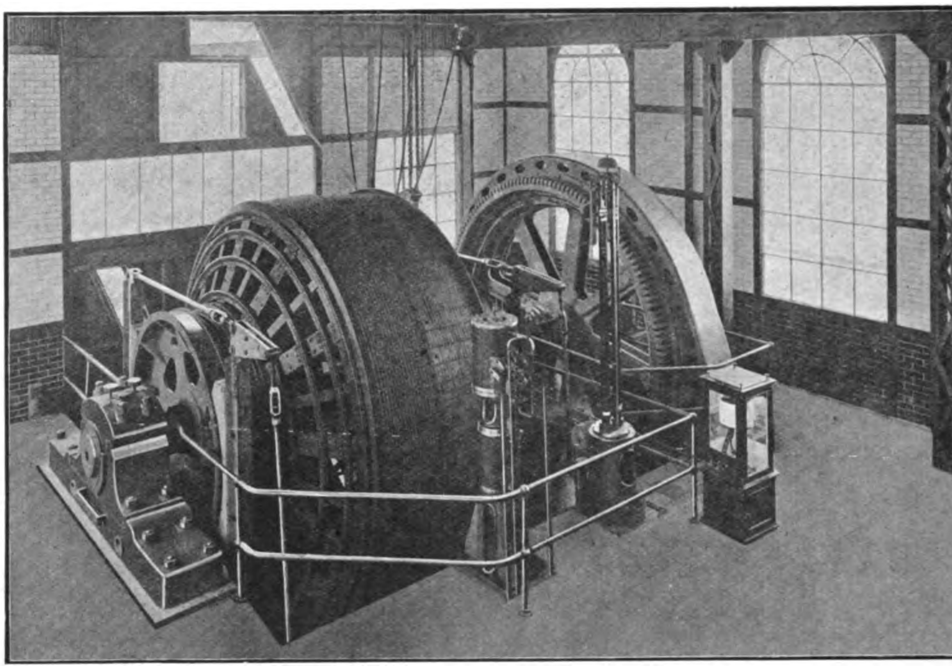
B.T.H. Steel Mill Motor with reduction gear, 1000 H.P.

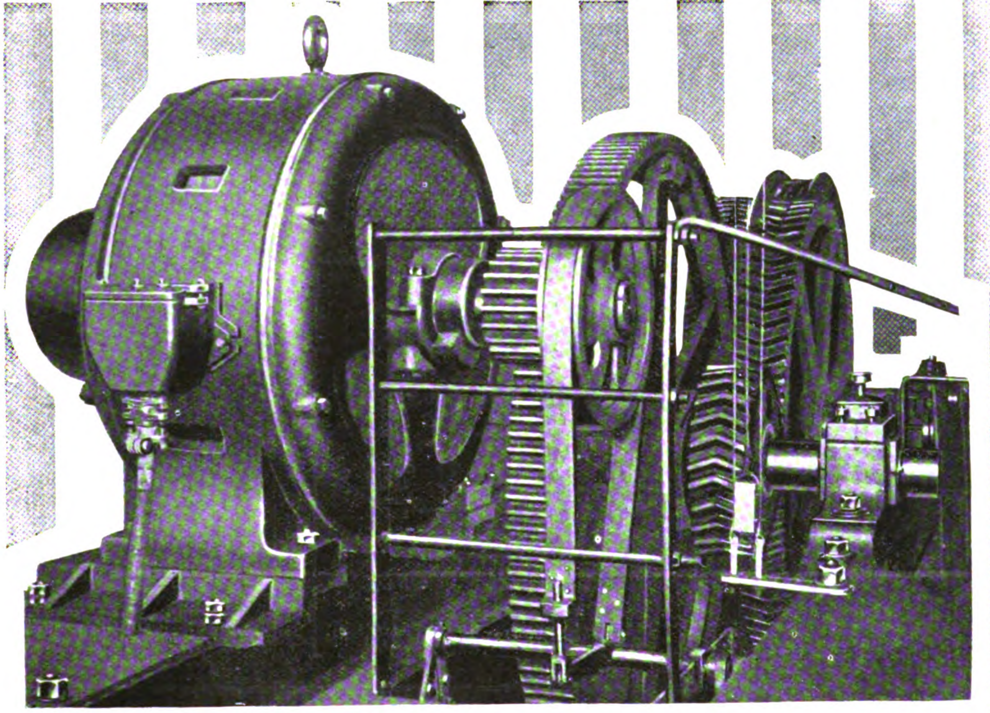


B.T.H. Truck Type Switchgear.



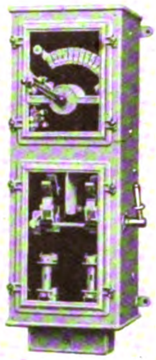
B.T.H. D.C. Generator.



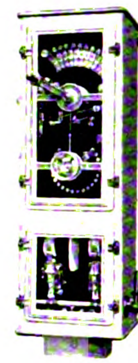


CUADROS DE DISTRIBUCIÓN

PARA MOTORES DE CORRIENTE CONTINUA

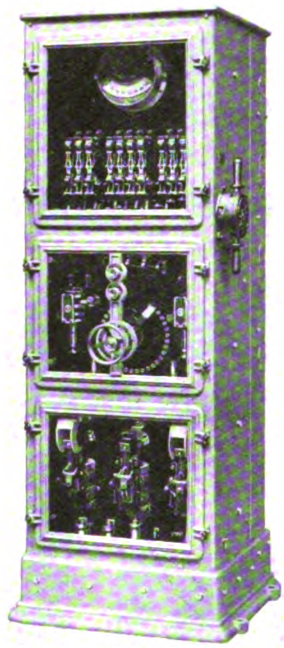


2 BW



12 BW

CS 2



ML 13

BS 2

13 CP

12 BP/R

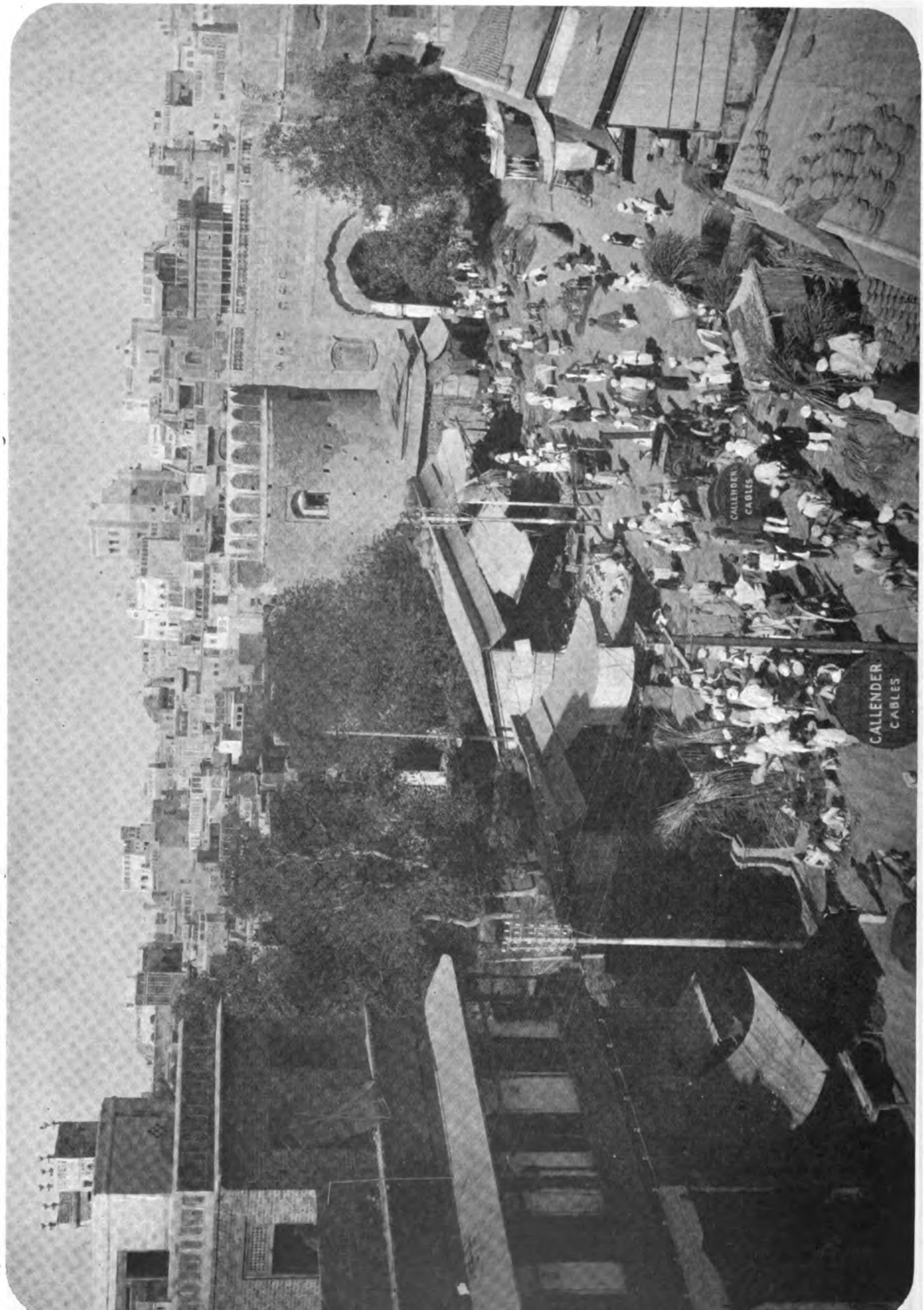
BROOK HIRST & C° L^TD

Northgate Electrical Works

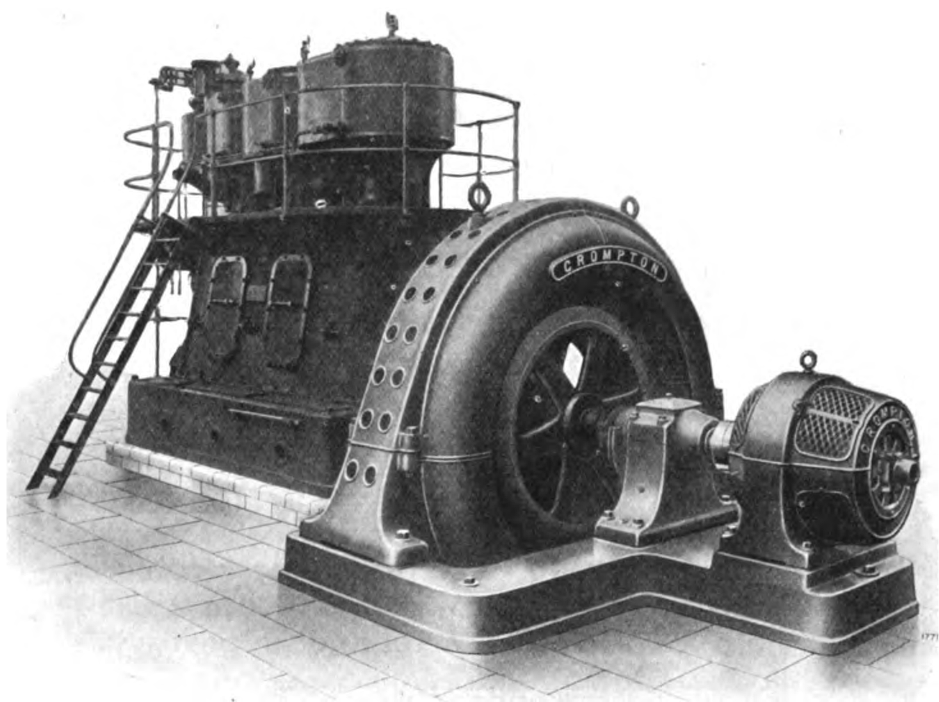
CHESTER

Presentamos en este anuncio muestras de nuestros cuadros de distribución.

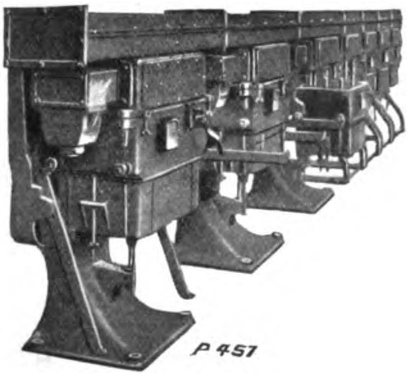
Informes completos y precios en nuestro catálogo No. 3.



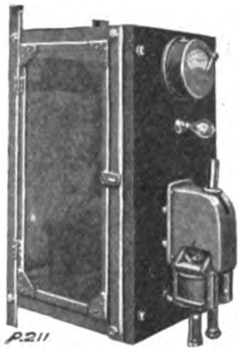
xxiii.



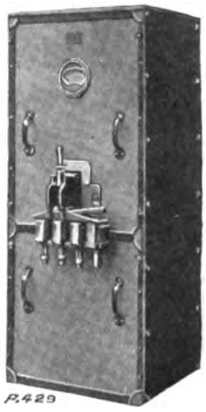
Juego de alternadores de vapor.



P.457



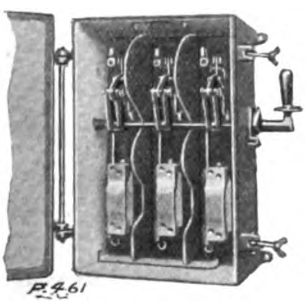
P.211



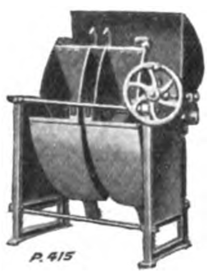
P.429

P.180

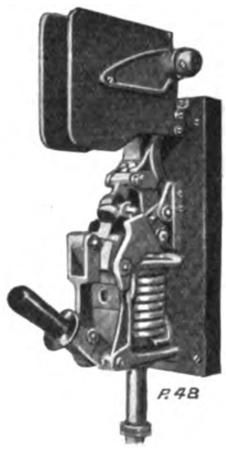
P.481



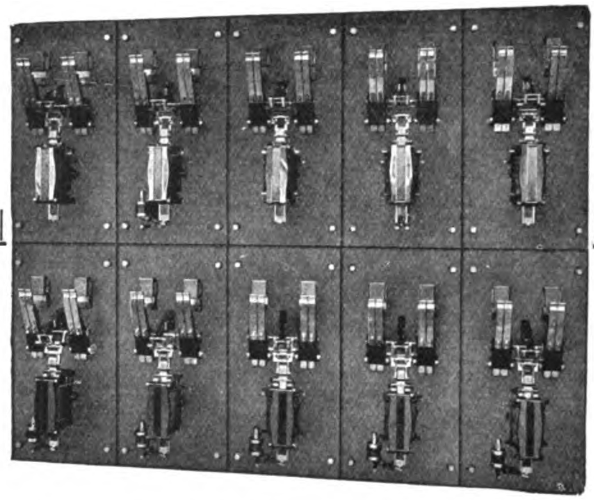
P.461



P.415



P.48



900 H.P., 440 volts, 40 cycles 3-phase operating Hydraulic Accumulator Set.

SAVE LABOUR.

INCREASE OUTPUT.

EMPIRE S. & C. HIGH-TENSION FUSE (Blown).
For 66,000 volts to 110,000 volts.

"EMPIRE" AUTOMATIC CONTROLLERS

MADE BY

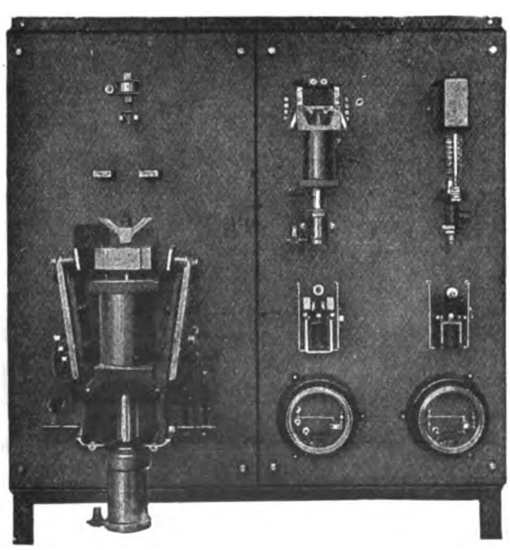
ELECTRIC CONTROL LIMITED, GLASGOW.

BRANCH OFFICES—
London. Newcastle. Belfast.
Manchester. Cardiff. Birmingham.

FOREIGN OFFICES—
Moscow. Turin.

EMPIRE S. & C. HIGH-TENSION FUSE.
For 1 to 100 amps.

200 H.P. Air Compressor Controller, with Shunt Regulator, and Unloading Device.

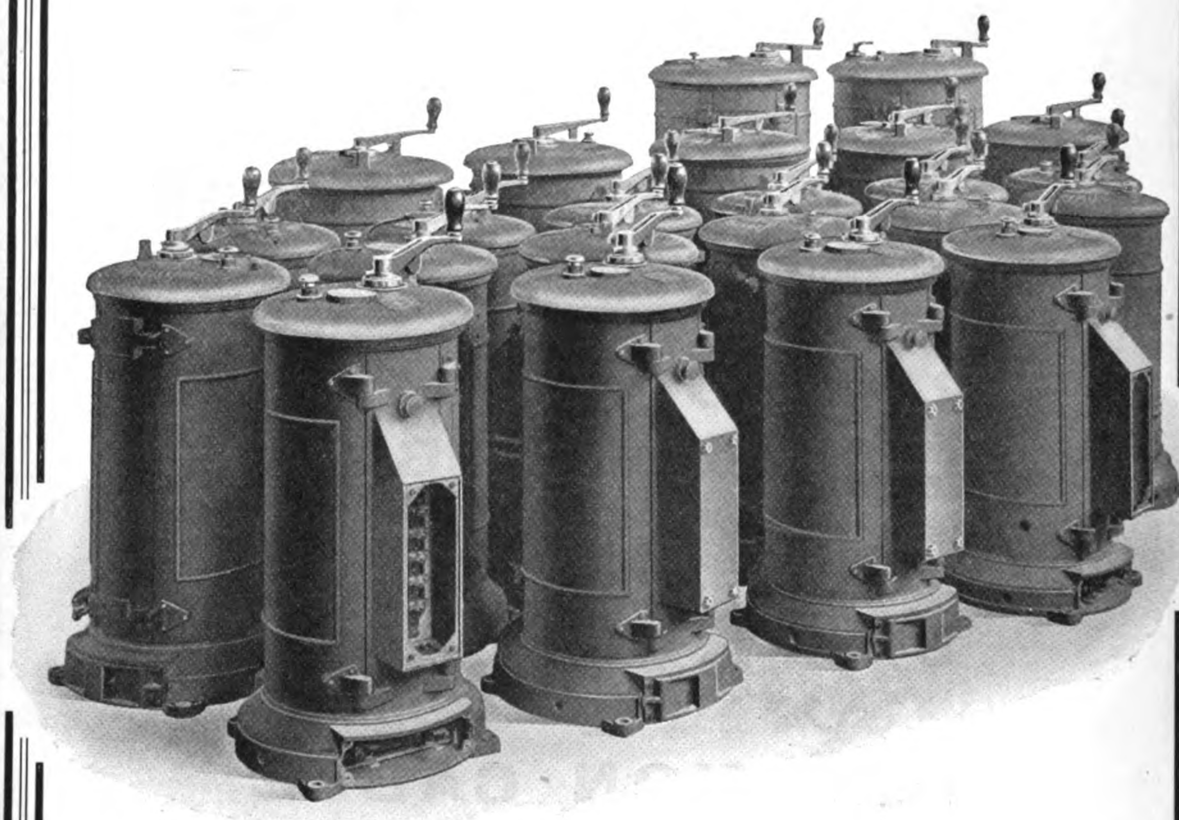


Write for Fuse Booklet.

Send us your Enquiries for Controllers.

VICKERS CONTROL PILLARS

For controlling motors driving all classes of machinery subjected to frequent starting and stopping operations.



THE ELECTRIC & ORDNANCE ACCESSORIES

COMPANY LIMITED. WARD END WORKS, BIRMINGHAM.

Telephone: 960 East. Telegrams: "Vickers, Birmingham."

PROPRIETORS VICKERS LIMITED

AGENTS:

LONDON: Electrical Department, Vickers House, Broadway, Westminster, S.W.

MANCHESTER: R. Foster, 196, Deansgate.

GLASGOW: J. & A. Anderson, 231, St. Vincent Street.

SHEFFIELD: H. E. Ridley, 19, Vainor Road.

AGENTS:

NOTTINGHAM: F. Mansfield, 197, Station Road, Beeston, Notts.

SWANSEA: W. Ogden Dayson, 1, Mount Street.

YORKSHIRE & THE TEES: F. MacCallum, Austhorpe Road, Crossgates, Leeds.

MIDLANDS: Bill & Berry, 39, Great Charles Street, Birmingham.

NEWCASTLE-ON-TYNE: T. J. Grainger & Co., Edinburgh Life Buildings, 21, Mosley Street.

A MELHOR QUALIDADE SEMPRE VALE MAIS

Os Fabricantes que tem tido o maior exito nos seus negocios sabem que as melhores machinas emfim funccionam com a maxima satisfacção. Elles se informam no primeiro lugar da qualidade da machina, a põem a prova para verificar a capacidade, exactidão e o trabalho que póde fazer. Logo que estão certos que tem descoberto a melhor machina, perguntam Qual é o preço? A despeza inicial deve-se regular pela qualidade. Ha muitas causas para a differença de preço entre as differentes offertas, mas a mais importante é a qualidade do material e do trabalho que póde dar. É falsa economia escolher a offerta mais baixa sem tomar em conta a utilidade e durabilidade da machina. É a qualidade que faz aos homens e as machinas dignas de confiança.

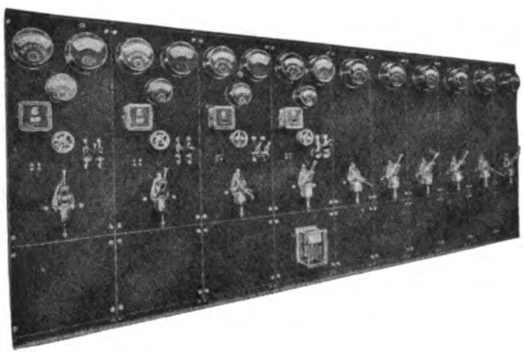
Os vendedores que tomam como base o preço da concurrencia, sempre perdem no fim, mas o comprador que se deixa enganar com um baixo preço perde ainda mais.

Se os compradores escolhessem unicamente os artigos de qualidade superior, elles ajudariam em fazer voar a Bandeira da Liberdade e do Progresso. Se elles favorecem os preços baixos á custo da qualidade não farão mais que preparar uma epoca de concurrencia excessiva que facilmente terá o effeito de exterminar tanto o comprador como o vendedor.

Os compradores podem ajudar a causa dos Alliados em collocar os seus pedidos com os fabricantes inglezes, ainda seja demorada algum tanto a entrega. Se tiverem necessidade de Motores, material ou de machinas electricas, devem consultar o Directorio de Fabricantes (Directory of Manufacturers) neste jornal, escrevendo aos membros que podem satisfazer as suas precisões.

Digitized by Google

EDISWAN



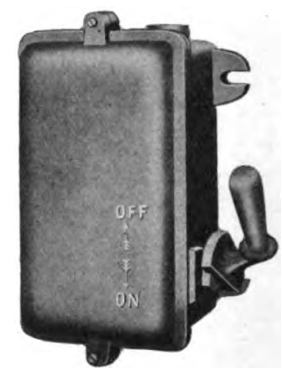
Los cuadros de distribución EDISWAN son los más perfectos que se conocen, entre otras razones porque nos esmeramos en su fabricación y empleamos materiales selectos. Si necesita Ud. un

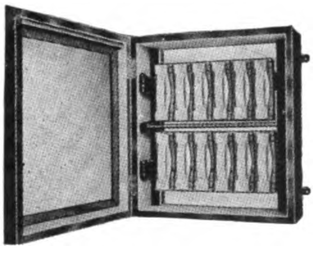
Cuadro de Distribución

sírvase escribirnos: podemos satisfacer su necesidad a un precio razonable.

Los interruptores y fusibles EDISWAN responden a las necesidades del comprador más exigente. Son absolutamente seguros, completamente impermeables y muy bien hechos en todo sentido.

Interruptores y Fusibles de Acción Rápida y Perfecta con Armazón de Hierro.





Los Cuadros de Distribución Ediswan se fabrican en varias clases y en tamaños apropiados para casas particulares pequeñas, talleres, fábricas, etc., etc.

Los productos EDISWAN son enteramente británicos.

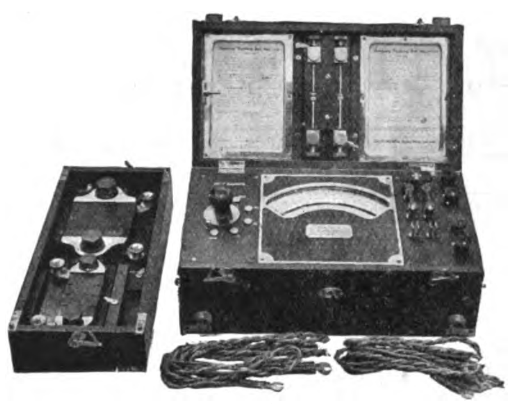
THE EDISON & SWAN ELECTRIC LIGHT COMPANY, Limited
PONDERS END, MIDDLESEX.
ENGLAND.

London Showrooms:— 123—125, Queen Victoria Street, E.C.;
71, Victoria Street, Westminster, W.

ELLIOTT

DYNAMOMETER INSTRUMENTS.

CENTURY
STANDARD TESTING SET



FOR MEASUREMENT OF

CURRENT - -	·0002 to 600 Amperes
VOLTAGE - -	·001 to 750 Volts
POWER- - -	·000002 to 450 K.W.
RESISTANCE - -	- ·000002 upwards
INSULATION - -	up to 5 Megohms

Overall Dimensions - $12\frac{5}{8} \times 9\frac{3}{16} \times 5\frac{3}{8}$ inches
Weight - $17\frac{1}{2}$ lbs. complete.

PRICES & FULL LISTS ON APPLICATION.

ELLIOTT BROTHERS. ESTABLISHED 1800. TELEPHONE — 4415 VICTORIA. TELEGRAPH-ELLIOTTIZE,VIC.LONDON.	CENTRAL BUILDINGS, WESTMINSTER, LONDON AND CENTURY WORKS, LEWISHAM, LONDON.S.E.

INSTRUMENTS OF ALL KINDS

Ammeters, Voltmeters, Wattmeters
Power Factor & Frequency Meters
Synchronisers, Photometers
Testing Sets, Insulation Testers
Protective Relays for all purposes

We manufacture every possible kind of electrical measuring instrumen- in the ROUND, SECTOR or EDGEWISE shape, both INDICATING and RECORDING (Graphic), for PORTABLE or SWITCHBOARD use on POWER, LIGHTING or WIRELESS circuits, either on LAND or on SHIPBOARD (watertight). Full particulars are given in our Catalogue, containing 200 pages, dealing with over 500 distinct Types, Sizes and Patterns of instruments which will be forwarded on application.

The Metrohm Insulation Testing Set *is light, compact, strong and simple in operation. Its indications are exceedingly accurate, and it can be relied upon to withstand rough treatment.*

EVERETT, EDGCUMBE AND CO., LTD.

117, Victoria St., WESTMINSTER.
Collindale Works, HENDON.

TEM V.S. UMA QUESTÃO DE FORÇA MOTRIZ A SOLVER?

PODE ser resolvida pelos membros desta associação. Elles tem adquirido uma grande experiencia na construcção de Generadores, Motores, etc. Sahem das suas officinas machinas electricas de toda especie. Tem elles munido as officinas, fabricas, caminhos de ferro, etc., em todas partes do mundo.

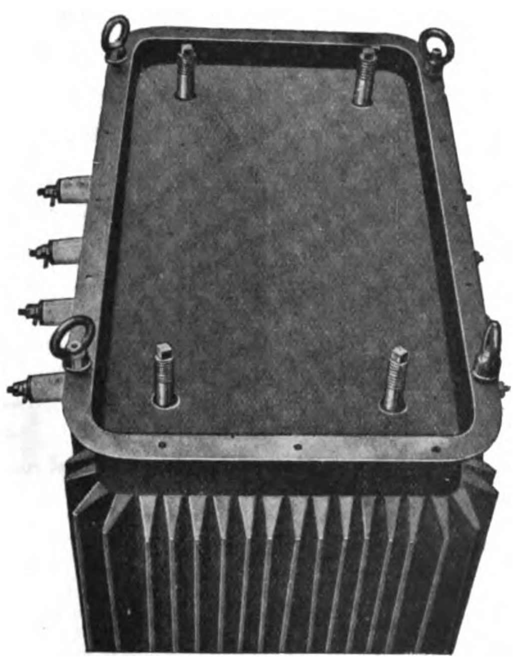
As casas fazendo parte da B.E.A.M.A. fabricam todos os accessorios necessarios. Luzes de arco, Luzes incandescentes e todos os seus accessorios. Utensilios e Apparelhos electricos de aquentar e de cosinha, Apparelhos commutadores de toda especie, Instrumentos para todos os fins commerciaes e toda classe de artigo electrico que precisarem na sua casa ou na officina, para estar ao corrente.

TRANSFOMADORES
FERRANTI

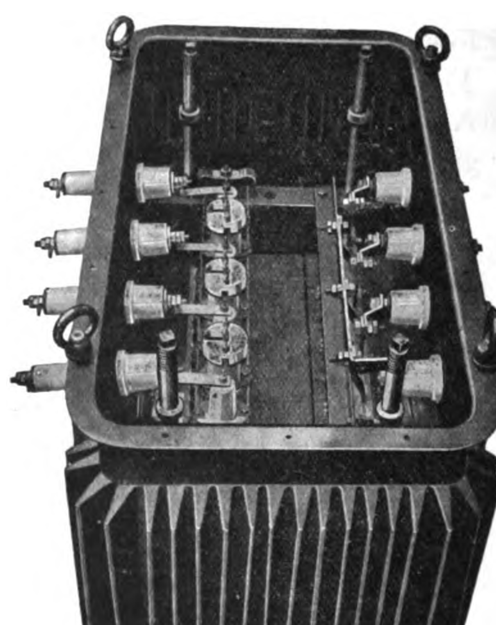
Disposición patendada para compensar el encogimiento de los carretes.

Borna especial patentada para varias tomas de corriente.

CUATRO INVENCIONES NOTABLES.



Flotador de aceite en posición.

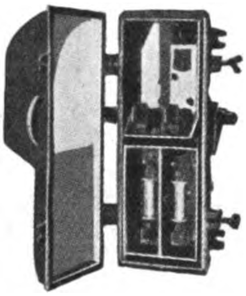


Bornas estancas.

TODOS TAMAÑOS HASTA 4,000 K.V.A.

FERRANTI LIMITED, HOLLINWOOD, LANCASHIRE, INGLATERRA.

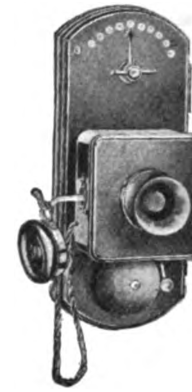
G.E.C.


Aparatos de distribución G.E.C.

Esta marca es símbolo de superioridad en el ramo de ingeniería eléctrica

Todos los artículos que anunciamos en esta página son enteramente británicos y representan lo mejor que en el Reino Unido se produce en nuestro ramo.
La G.E.C. tiene en sus talleres operarios habilísimos, y entre su personal superior figuran hombres de ciencia eminentes por su singular competencia y vasta experiencia.
Listas de precios y folletos ilustrados se remiten gratis a quien los solicite.


Planchas eléctricas "Magnet" G.E.C.
Tostadores "Magnet" G.E.C.
Cafeteras eléctricas G.E.C.


Teléfonos G.E.C.


Instrumentos de medida.


Ventiladores de escape G.E.C.


Calentadores eléctricos "Magnet" G.E.C.

The General Electric Co., Ltd.

Head Office: **67, Queen Victoria St., London, Eng.**

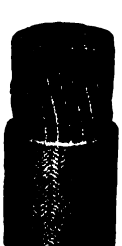
Cablegrams: "Polyphase, London."

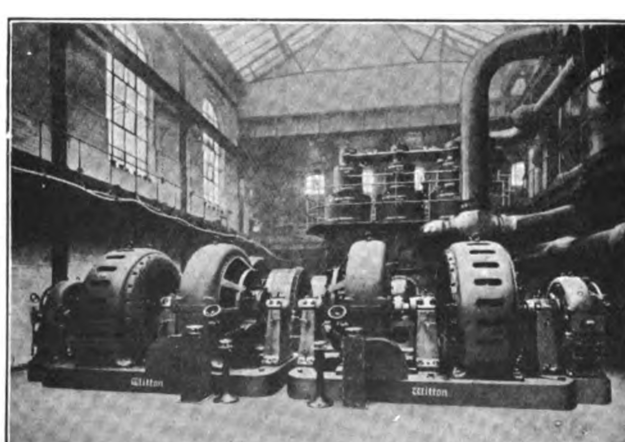
Agencias de la América del Sur:
Buenos Aires (Argentina)—Anglo-Argentine General Electric Co., Ltd., 1475 Rivadavia. 1483 Plaza del Congreso.
Valparaiso (Chile)—Huth & Co.
Santiago (Chile)—Huth & Co.
Concepción (Chile)—Huth & Co.
Lima (Perú)—Duncan Fox & Co.; also at **Callao, Piura** and **Payta.**


Motores de baja potencia G.E.C.


Campanillas G.E.C.


Ventiladores eléctricos 'Freezor' G.E.C.


Cables G.E.C.


Instalaciones eléctricas G.E.C.

Pilas secas G.E.C.


Strength
The filament of OSRAM is made of the purest and best tungsten by the latest and most improved methods of manufacture. This — with the extreme care shown in its drawing, winding and mounting — accounts for its wonderful strength. OSRAM stands knocks, shock and vibration. It is British, not only in manufacture, but in the standard of its workmanship.
Osram
DRAWN WIRE
Lamps
Made at The Osram-Robertson Lamp Works, Hammersmith, London.
Advt. of The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.

ESTE grabado ilustra la colocación de cables HENLEY para electrificar las líneas suburbanas del Ferro Carril Oeste, de Buenos Aires. Nuestros competentísimos ingenieros y operarios han llevado a cabo instalaciones eléctricas en diversas partes del mundo, y la dilatada experiencia obtenida de este modo nos permite ejecutar cualquier trabajo del ramo en condiciones sumamente económicas. Claro está que si Ud. sólo necesita cables y alambres eléctricos, no tenemos inconveniente alguno en señalarle precios por cantidades grandes o pequeñas.

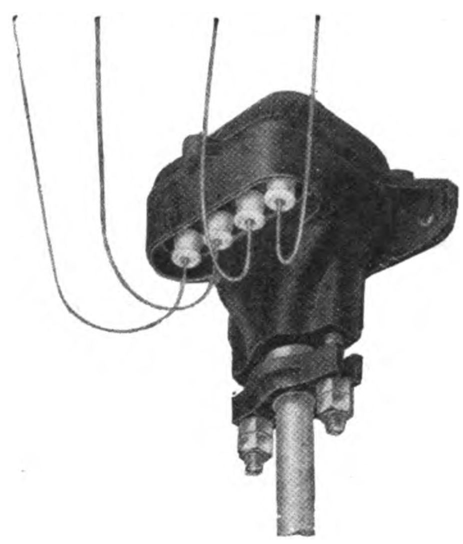
La Casa Henley figura entre las más importantes de la Industria Eléctrica desde el año 1837.

CABLES, Y CAJAS PARA JUNTAS, DE "HENLEY"

TRADE MARK

TRADE MARK

CAJAS TERMINALES SISTEMA HENLEY.



Son las más baratas de conectar.
Ligadura automática.
No requieren juntera de plomero.
Entrega inmediata.

Informes completos en nuestro catálogo T 104.

W. T. HENLEY'S TELEGRAPH WORKS Co. Ltd.

BLOMFIELD STREET, LONDRES, E.C.

AGENTES EN LA ARGENTINA:—
BUXTON, OLDITCH & Cia.,
Suipacha 602, esq. Tucumán,
BUENOS AIRES.

AGENTES EN ESPAÑA y PORTUGAL:—
ADOLFO SEGHERS,
Calle de Ayala 23, MADRID.
ADOLFO SEGHERS,
Rua do Alecrim, 79, LISBOA.

HICK, HARGREAVES & C^{o} L^{d}

ENGINEERS,

BOLTON, — — — England.

CONDENSERS

MULTI-JET AND SURFACE
FITTED WITH

HICK-BREGUET EJECTAIRS

FOR

HIGH VACUUM.

SIMPLE AND RELIABLE.

LOW MAINTENANCE COST.

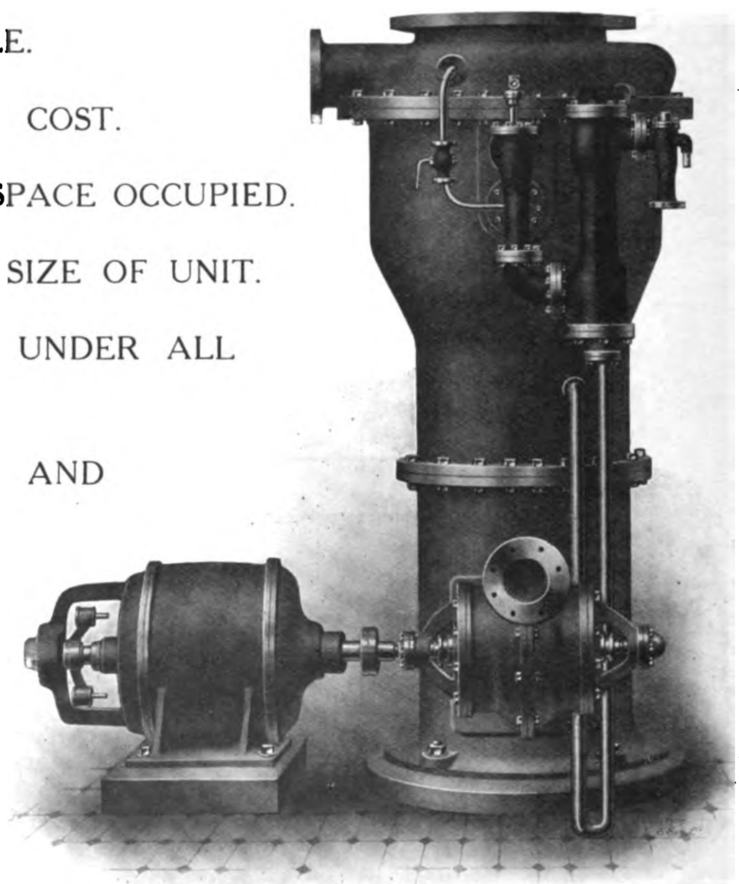
SMALL WEIGHT AND SPACE OCCUPIED.

SUITABLE FOR ANY SIZE OF UNIT.

PERFECT STABILITY UNDER ALL CONDITIONS.

HIGHEST ECONOMY AND EFFICIENCY.

SILENT
AND
CLEAN.



Telephone: 1373/4 Bolton.

Telegraphic: "Hick, Bolton."

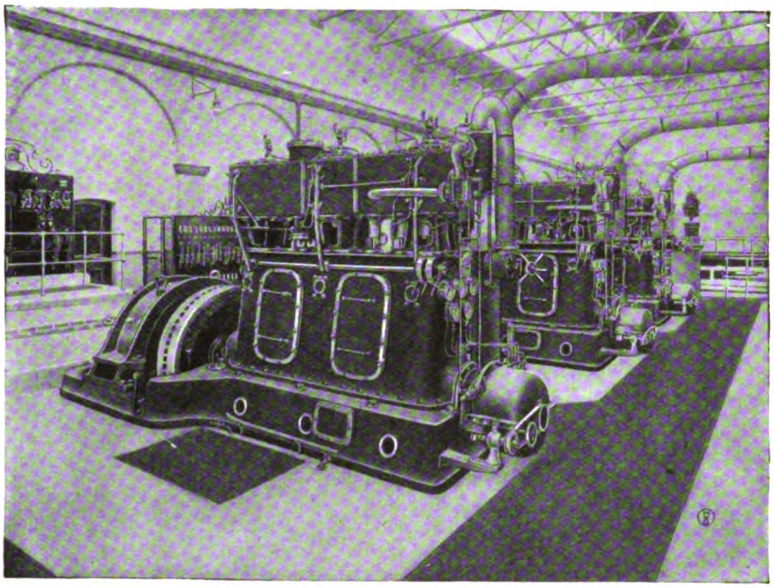
JAMES HOWDEN & CO., LTD.

Manufacturers of

HIGH SPEED ENCLOSED ENGINES

10 B.H.P. to 2,500 B.H.P. ALL TYPES.

FOR MILLS, COLLIERIES, FACTORIES, CENTRAL STATIONS, Etc.



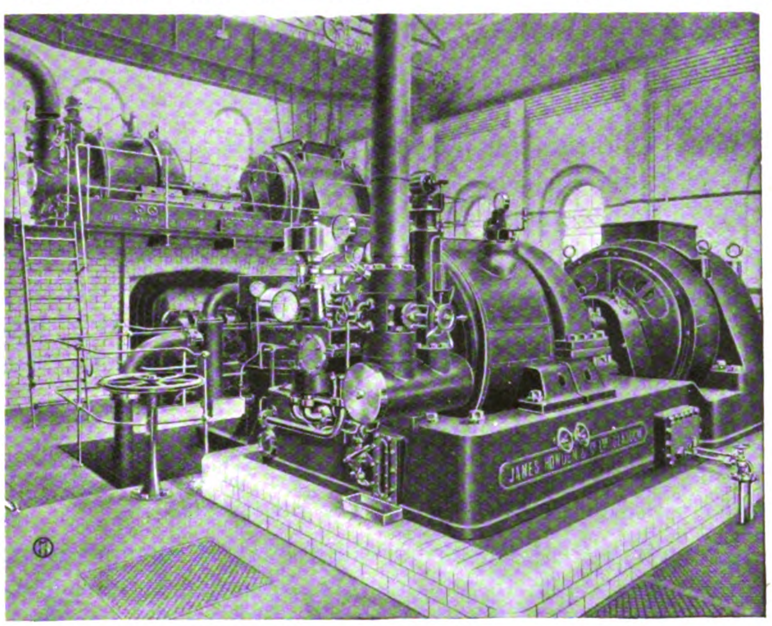
ECONOMY, RELIABILITY, LOW RUNNING COSTS.

SHIELDHALL SEWAGE WORKS, GLASGOW. TOTAL B.H.P. 1,200.

IMPULSE STEAM TURBINES

HIGH, LOW AND MIXED PRESSURE TYPES. 300 KWTS TO 20,000 KWTS.

SPECIALLY RECOMMENDED FOR LARGE UNITS.



HIGH EFFICIENCY.

LOWEST STEAM CONSUMPTION.

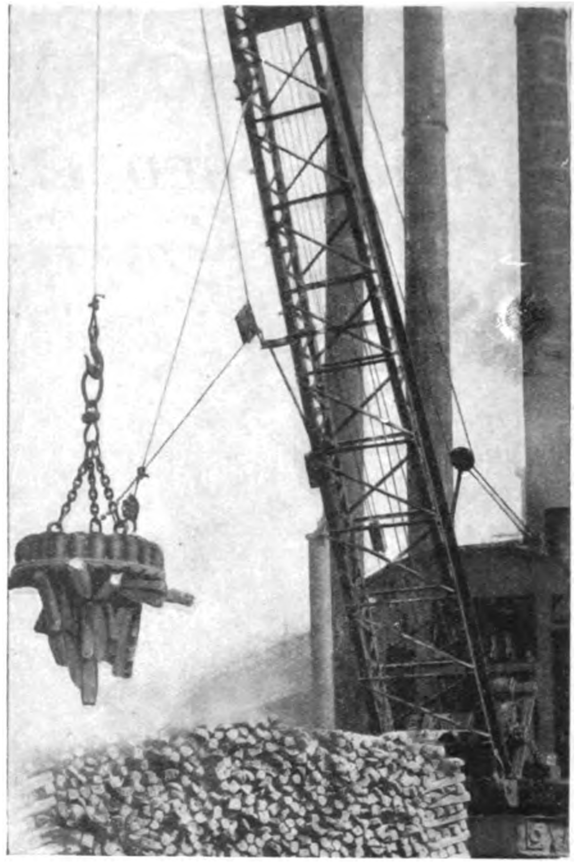
WARRINGTON CORPORATION. TOTAL B.H.P. 5,000.

HOWDEN'S FORCED DRAUGHT SYSTEM

16,000,000 I.H.P. FITTED.

HEAD OFFICE & WORKS:
SCOTLAND STREET, GLASGOW.

LONDON: CAXTON HOUSE, S.W.
MANCHESTER: 86, CROSS STREET.
NEWCASTLE: 90, PILGRIM STREET.

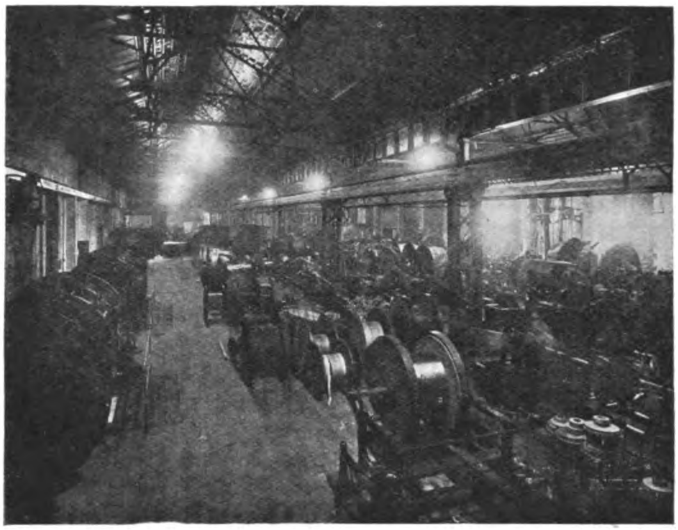


SI hasta la fecha no ha comprado Ud. máquinas eléctricas y de vapor de nuestros miembros, hoy tiene Ud. a su alcance una hermosa oportunidad para entablar provechosas relaciones con ellos.

Los miembros de la ASOCIACIÓN BRITÁNICA DE FABRICANTES DE MATERIALES DE ELECTRICIDAD Y RAMOS AFINES producen artículos de inmejorable calidad, y los venden a precios equitativos.

Comprar mercancías británicas es comprar lo mejor, pues nadie ignora que la excelente reputación del REINO UNIDO está cimentada sobre la superioridad de sus productos.

Recomendamos a Ud. escribir sin pérdida de tiempo a las casas que le interesen y aun formular sus pedidos con anticipación, pues debido a escasez de personal, algunos fabricantes no pueden despachar los pedidos con la rapidez que desearan.



View in one of our Cable Shops at Charlton.
(Night photo, showing Metroflam Lighting).

CABLES

For Working Pressures up to 30,000 VOLTS.

V.I.R. Cables, Wires and Flexibles, Association and Non-Association Classes.

Paper-Insulated Lead-covered and Armoured Cables.

Vulcanised Bitumen Cables, to Mining Rules.

Telephone Cables—Dry Core, Armoured and Non-Armoured.

Trailing Cables—Cab Tyre Sheathed and Hard Cord Braided.

Aerial Cables, Fire and Acid Resisting Cables, Signal and Shot-firing Cables, Bell Wires, etc., etc.

CONTRACTORS FOR COMPLETE LIGHTING AND POWER SCHEMES, UNDERGROUND AND OVERHEAD TRANSMISSION LINES, ETC.

DYNAMOS AND MOTORS

SWITCHGEAR for all purposes

TRANSFORMERS

INSTRUMENTS

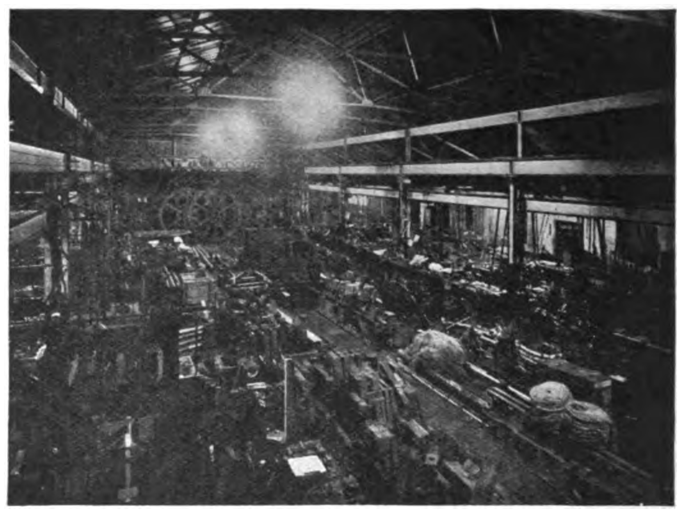
ARC LAMPS. The "Metroflam" long burning Flame Lamp is the cheapest high-power light.

SEARCHLIGHTS

INCANDESCENT LAMPS AND FITTINGS

LINE MATERIAL & INSULATORS

EVERY ELECTRICAL REQUISITE



View in one of our Engineering Shops at Charlton
(Night photo, showing Metroflam Lighting).

Established 1875.

JOHNSON AND PHILLIPS LTD CHARLTON, LONDON, S.E.

Cablegrams: "Juno, London."

CONTRACTORS TO BRITISH AND COLONIAL GOVERNMENTS.

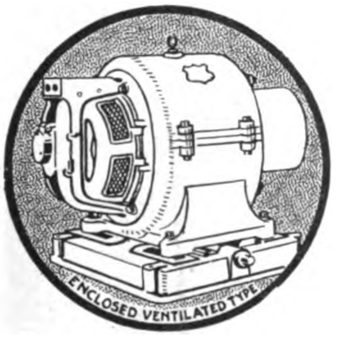
Branch Offices and Stores:

206, Corporation Street, Birmingham.
9, Park Place, Cardiff.
159, West George Street, Glasgow.
251, Deansgate, Manchester.
44b, Blackett Street, Newcastle-on-Tyne.

Agents:—

SOUTH AFRICA. R. H. Gould & Co., Basement, Trust Buildings, Johannesburg.
NEW SOUTH WALES.—N. Guthridge, Ltd., Equitable Buildings, George Street, Sydney.
NEW ZEALAND.—Tolley & Sons, Ltd., Chews Lane, Wellington.
INDIA.—Turner, Hoare & Co., Electrical Engineers, Bombay. Balmer, Lawrie & Co., Electrical Engineers, Calcutta.

LANCASHIRE DYNAMO & MOTOR COMPANY LTD.



"LANCASHIRE" ELECTRICAL PLANT

gives continuous and satisfactory service in operation.

Every detail is designed and made as though the whole life of the machine depended on it, and that is why the name LANCASHIRE as applied to

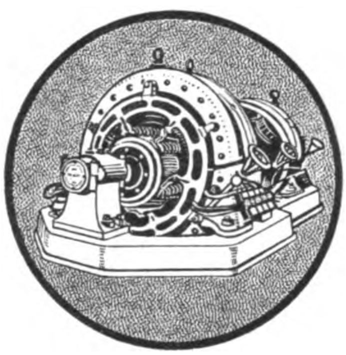
Generators and Motors

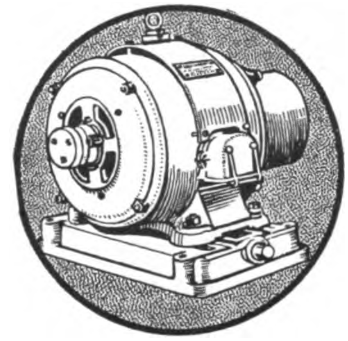
is indicative of the HIGHEST POSSIBLE STANDARD, both as regards design and manufacture.

We design and manufacture at Trafford Park D.C. & A.C.

Generators and Motors, Boosters and Balancers.

We specialize in the electrical equipment of works and factories. SEND FOR LISTS.





LAS INSTALACIONES ELÉCTRICAS

"LANCASHIRE"

funcionan perfectamente y producen beneficios incalculables al comprador. La razón es muy clara y sencilla: prestamos suma atención a cada detalle, como si de él dependiera la duración de toda la máquina.

No es pues de extrañar que el nombre LANCASHIRE sobre un MOTOR o GENERADOR constituya de por sí una GARANTÍA de EXCELENCIA.

Proyectamos y fabricamos en **Trafford Park** generadores y motores de corriente continua y alternada, elevadores de tensión y equilibradores.

ESPECIALIDAD: instalaciones electricas para talleres y fábricas.

Informes y listas de precios gratis.

AGENCIAS Y OFICINAS EN EL EXTRANJERO:

ESPAÑA: Macnaughton Hnos., Llano del Remedio 2, VALENCIA.

FRANCIA: Rollett & Cia., 64, Rue de la Folie Méricourt, PARIS.

HOLANDA: Landre & Glinderman, Ingenieros, AMSTERDAM.

CANADÁ: The Lancashire Dynamo & Motor Co., Ltd. (of Canada), 152-4, Bay Street, TORONTO; id. en Nicholas Building, MONTREAL.

JAPÓN: Jardine Mattheson & Cia., Nachf 1, YOKOHAMA.

Dirección telegrafica: "Ironclad, Manchester" (Inglaterra).

AS INSTALLAÇÕES ELECTRICAS

"LANCASHIRE"

funccionam perfeitamente e produzem grandes beneficios ao comprador. A razão é muito clara e simples Dedicamos a maior attenção a cada detalhe como se dependesse disso a duração da inteira machina.

Por isso não é para admirar que o nome "LANCASHIRE" sobre um MOTOR ou GENERADOR constitua por si mesmo uma garantia de EXCELLENCIA

Projectamos e fabricamos em **Trafford Park** generadores e motores de corrente continua e alternada, elevadores de tensão e equilibradores.

ESPECIALIDADE: Installações electricas para Officinas e Fabricas.

Dão-se pormenores e listas a pedido gratis

AGENCIAS E ESCRIPTORIOS NO EXTRANGEIRO:

HESPANHA: Macnaughton Hnos., Llan del Remedio 2, VALENCIA.

FRANÇA: Rollett et Cie., 64, Rue de la Folie Méricourt, PARIS.

HOLLANDA: Landre & Glinderman, Engenheiros, AMSTERDAM.

CANADÁ: The Lancashire Dynamo & Motor Co., Ltd. (of Canada), 152-4, Bay Street, TORONTO, id em Nicholas Building, MONTREAL.

JAPÃO: Jardine Mattheson & Co., Nachf 1, YOKOHAMA.

Direcção telegraphica: *Ironclad, Manchester (Inglaterra).*

FOREIGN OFFICES AND AGENTS:

CANADA: THE LANCASHIRE DYNAMO & MOTOR CO., LTD. (of Canada), 152-4, Bay Street, Toronto; also at St. Nicholas Building, Montreal. JAPAN: JARDINE MATTHESON & Co., Nachf 1, Yokohama. ESPAÑA: MACNAUGHTON BROS., Llano del Remedio 2, Valencia. FRANCE: ROLLETT ET CIE., 64, Rue de la Folie Méricourt, Paris. HOLLAND: LANDRE & GLINDERMAN, Ingenieurs, Amsterdam. РОССІЯ: С. Г. Мартинъ и Ко., Улица Гоголя № 21, Петроградъ; тоже Варварка, Средніе Ряды № 242-243, Москва.

LANCASHIRE DYNAMO & MOTOR CO. LTD.

TRAFFORD PARK – MANCHESTER

Cables: IRONCLAD, Manchester, England.

SE não tiverem já comprado as suas machinas electricas, machinas a vapor e accessorios dos fabricantes inglezes, eis aqui um momento opportuno para começar relações com os membros da Associação de Fabricantes inglezes, de machinas electricas e outros artigos alliados (B.E.A.M.A.) Elles fabricam toda a classe de artigo da mais alta qualidade, e aos mais baixos preços tendo em vista a qualidade. Os artigos inglezes são sempre os melhores e dignos da maior confiança e por isso uma boa escolha sempre dará inteira satisfacção.

É possivel que haja em alguns casos demora na entrega o que é inevitavel, e roga-se aos senhores compradores que dêem os seus pedidos anticipadamente extendendo o mais possivel o prazo de entrega.

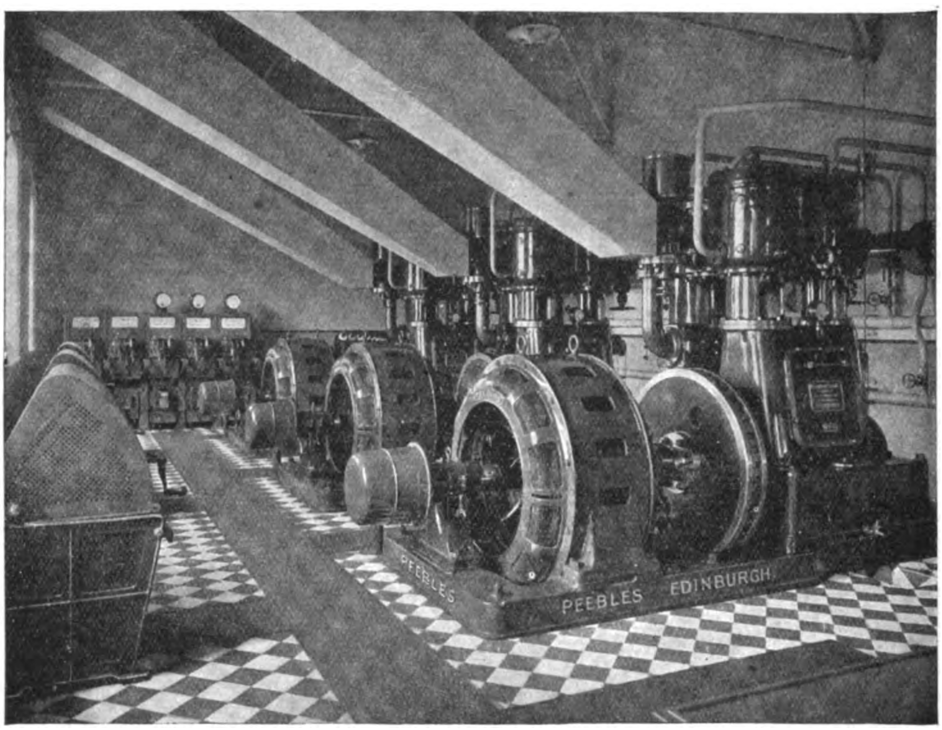
O DIRECTORIO CLASSIFICADO DE GENEROS

neste jornal é de grande ajuda aos compradores. As classificações tem sido feitas com cuidado para facilitar a busca, e os indices em inglez, francez, hespanhol e russo, facilitam aos compradores que conhecem estes idiomas a achar facilmente o que precisam. Os nossos leitores devem consultar este Directorio e escrevér directamente aos membros cujos nomes e endereços se acharão ao fim. As paginas de annuncios contem os nomes dos agentes para o extrangeiro, das differentes casas.

PEEBLES

ELECTRICAL MACHINERY

Parte interior de una instalacion de compresores de aire perteneciente a una conocidisima Empresa de diques.
Esta lamina muestra asimismo tres motores PEEBLES de corriente alternada y de 160 caballos de fuerza britanicos, acoplados a compresores de aire BELLISS.



Interior of Air Compressor House of a well-known Dock Company, showing three Peebles 160 B.H.P. Slip Ring Motors coupled to Belliss Air Compressors. 2182

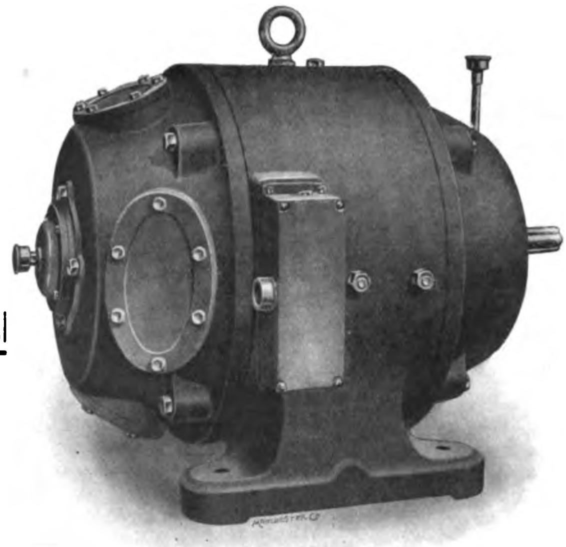
BRUCE PEEBLES & CO., LTD.,

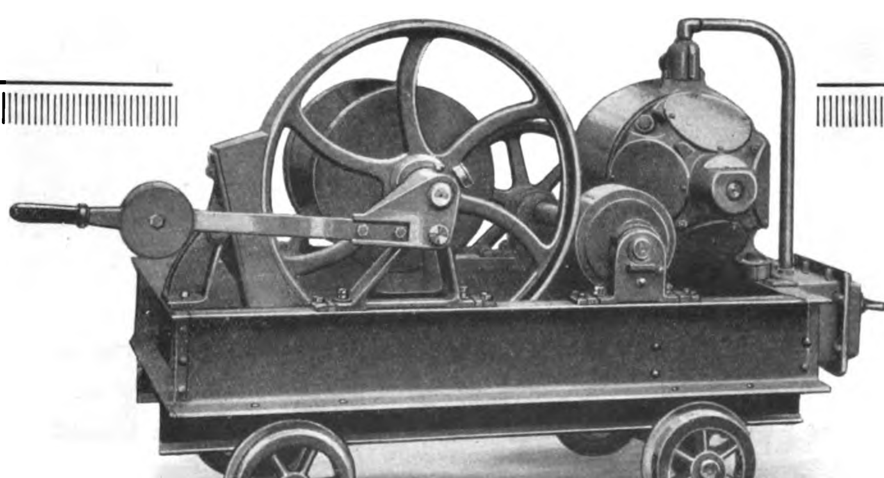
Telegrams: "Peebles, Edinburgh."

Engineers,
EDINBURGH.

Telephones: 1867-8-9 Central.

L'ALMANACK CLASSIFIÉ DE MARCHANDISES dans ce journal est une aide de grande valeur aux acheteurs. Les classifications ont été faites avec soin pour faciliter les recherches, et les index en anglais, français, espagnol, et russe, mettent l'acheteur qui parle ces langues en état de trouver facilement ce qu'il cherche. Les lecteurs doivent consulter cet almanack et écrire directement aux membres dont les noms et les adresses se trouvent à la fin. Les pages d'annonces contiennent les noms des agents pour l'étranger des différentes maisons.

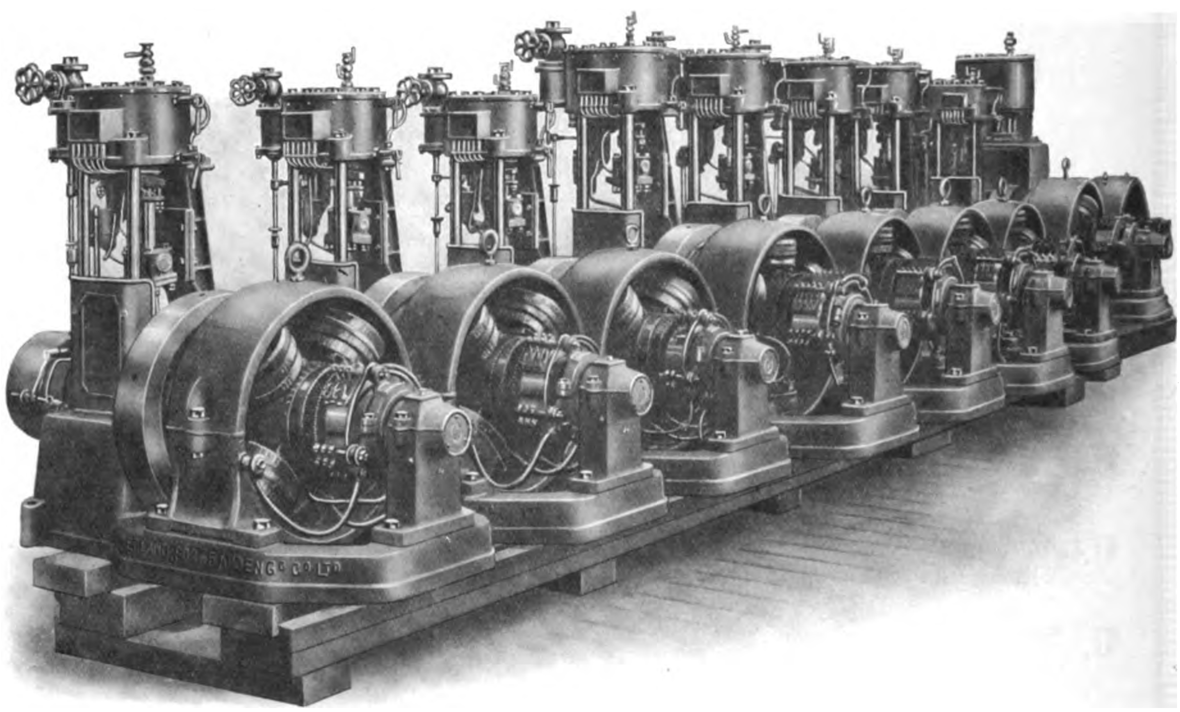




The Sunderland Forge & Engineering Co., Ltd.

PALLION, SUNDERLAND.

Telegrams: "Marr, Sunderland." **Telephone Nos. 1232, 1233, 1234 Sunderland.**



A GROUP OF STANDARD COMBINED PLANTS.

Direct-Coupled Steam Engines and Dynamos.

STANDARD SIZES MADE TO STOCK. 3 Kw. to 25 Kw. 100 or 110 volts.

GOOD DELIVERIES for Other Voltages.

LARGER SIZES FITTED WITH COMPOUND ENGINES.

Also Manufacturers of Electric Winches.

DIRECTORIO DE FABRICANTES, ORDENADO ALFABÉTICAMENTE.

Este DIRECTORIO, redactado en inglés, francés, castellano y ruso, permite al que esté familiarizado con cualquiera de estos idiomas, encontrar en seguida el artículo que necesita.

Recomendamos a Ud. consultarlo y escribir directamente a los miembros; cada nombre va seguido de la respectiva dirección completa.

En las páginas de anuncios hallará Ud. además la lista de sus agentes en el extranjero.


PAZ y PROGRESO
ASÍ como la victoria de los aliados ha de restablecer la paz y la libertad destruídas por el militarismo, de igual modo el triunfo de la industria británica ha de proclamar en el mundo una era de bienestar y progreso, facilitando los medios de producir artículos excelentes a precios relativamente bajos.
Comprar máquinas de la Gran Bretaña es ayudarse a sí mismo y contribuír a un fin humanitario.

REVISTA BEAMA

SECCIÓN ESPAÑOLA

LA INDUSTRIA ELÉCTRICA INGLESA EN EL MUNDO.

¿ Por qué—se habrá Ud. preguntado una y cien veces—goza de tanta popularidad la industria eléctrica inglesa y marcha triunfante por el mundo, a pesar de la ruda competencia de otras naciones ? Por dondequiera que uno vuelve la vista le salen al encuentro máquinas del Reino Unido : las hay en España, en Portugal, en Francia, en Suecia, en Rusia . . ; hailas en la India y en la China ; hailas en Marruecos y en Egipto ; hailas en el Canadá, en Méjico, Venezuela, Colombia, Brasil, Chile, la Argentina, el Uruguay. . . .

¿ Por qué ocupan los productos británicos lugar preferente en todas partes del mundo ? ¿ A qué obedece tal supremacía ? Sola y sencillamente a la indiscutible superioridad de los artículos ingleses, cuyos fabricantes tienen por principal preocupación la buena calidad.

Podrá alguno dejarse tentar por los bajos precios de fabricantes extranjeros y comprar sus máquinas, pero no tarda en descubrir que la economía es aparente y antes constituye una fuente de pérdidas ; y amargamente desconcertado, se dirige hacia la Gran Bretaña salvadora, cuyos productos jamás dan motivo para descontento. Y he aquí que tal experiencia le convierte en amigo leal del Reino Unido y en propagandista activo y desinteresado de sus mercancías, y le hace pregonar a voz en cuello su excelencia y estampar como lema de su empresa la frase : LO MEJOR ES LO MÁS BARATO.

. . .

Si el espacio no lo impidiera, reproduciríamos aquí vistas de numerosísimos Establecimientos donde hay máquinas de la Gran Bretaña funcionando a gusto de los compradores ; pero por no hacer este número demasiado voluminoso, nos contentaremos con publicar unas pocas. Ellas, no obstante, permitirán formarse idea de la popularidad que disfrutan los productos de las Islas Británicas. . . . (V. págs. 90-94).

JORGE DE CAMPOBELLO.

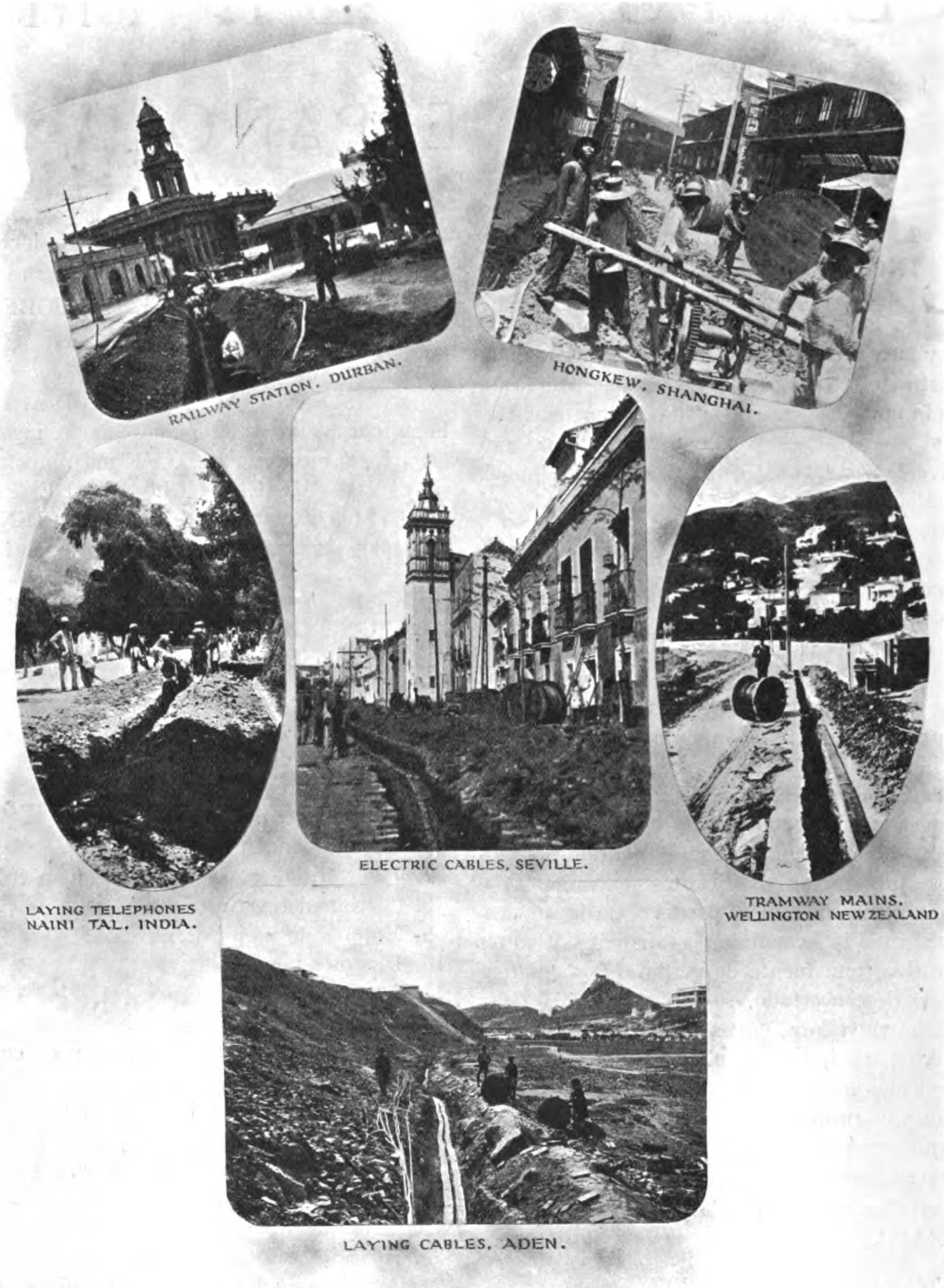
LA ASOCIACIÓN B.E.A.M.A. ocupa lugar conspicuo en el mundo de la ingeniería eléctrica y mecánica. . . . Sus miembros tienen un capital de CIEN MILLONES DE PESOS ORO ($100,000.000, oro) y emplean CIEN MIL (100.000) personas en sus talleres y fábricas.

La Asociación B.E.A.M.A. comprende las SECCIONES siguientes :

1. Accesorios para el alumbrado eléctrico, fuerza motriz, etc.
2. Acumuladores.
3. Lámparas de arco.
4. Instrumentos para el comercio.
5. Compresores de aire.
6. Plantas condensadoras.
7. Tubos aisladores y accesorios para tubos.
8. Combinadores eléctricos.
9. Motores de aceite de Diesel.
10. Dinamos y motores.
11. Accesorios.
12. Motores de gas.
13. Aparatos eléctricos de caldeo y de cocina.
14. Lámparas incandescentes.
15. Instrumentos eléctricos.
16. Contadores.
17. Bombas de vapor e hidráulicas.
18. Turbinas de vapor.
19. Máquinas de vapor.
20. Aparatos de distribución.
21. Aparatos telegráficos, telefónicos y de señales ; y baterías primarias.
22. Transformadores.

Todos los pedidos, grandes o pequeños, se atienden con el mayor esmero. La principal preocupación de nuestros miembros es satisfacer al comprador en todo sentido.

LA INDUSTRIA ELÉCTRICA INGLESA EN EL MUNDO

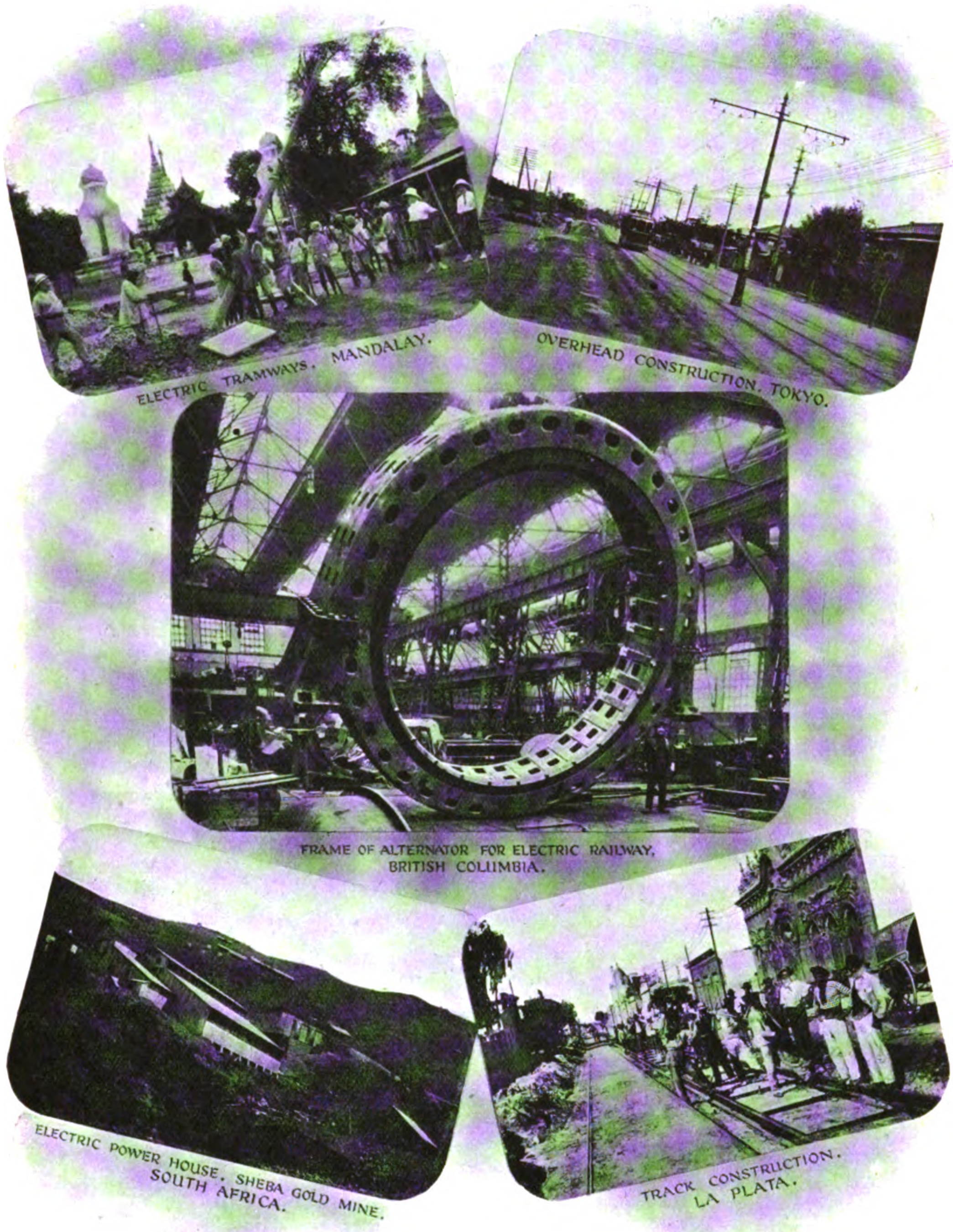


ESTACIÓN DE FERROCARRIL, DURBAN. HONGKEW, SHANGHAI.

COLOCACIÓN DE TELÉFONOS EN NAINI, INDIA. CABLES ELÉCTRICOS, SEVILLA. TRANVÍAS, WÉLLINGTON, NUEVA ZELANDIA.

COLOCACIÓN DE CABLES EN ADÉN.

LA INDUSTRIA ELÉCTRICA INGLESA EN EL MUNDO



TRANVÍAS ELÉCTRICOS DE MANDALAY. CONSTRUCCIÓN DE LÍNEAS AÉREAS EN TOKÍO.

ARMADURA DE UN ALTERNADOR PARA FERROCARRIL ELÉCTRICO, COLOMBIA BRITÁNICA.

CENTRAL DE ENERGÍA ELÉCTRICA EN ÁFRICA MERIDIONAL. CONSTRUCCIÓN DE UN FERROCARRIL EN LA PLATA.

INSTALACIÓN ELÉCTRICA PARA UN MUSEO DE BOMBAY
ACTUALMENTE USADO COMO HOSPITAL DE LADY HARDINGE PARA TROPAS INDIAS.

TUBERÍA (SISTEMA HIDROELÉCTRICO) INSTALADA EN TYSSEFALDENE, NORUEGA.

IDEALES DE LOS BELIGERANTES

El interesante artículo que insertamos a continuación aparecio el 1º de Mayo 1915, en *Hispania*, importante revista latino-americana editada en Londres y consagrada a Política, Comercio, Literatura, Artes y Ciencias.

El autor, Don Miguel de Unamuno, es Rector de la antiquísima e ilustrísima Universidad de Salamanca, e indudablemente un escritor honrado a carta cabal; este es un hecho que nadie pone en duda: ni siquiera sus enemigos más encarnizados.

Por eso el siguiente artículo, concienzudo como todos los que brotan de su fecunda pluma, vale por sí solo cien veces más que toda la hojarasca que publican los *germanófilos por conveniencia*.

LA UNIDAD DEL PUEBLO DE PRESA. POR DON MIGUEL DE UNAMUNO.

Un amigo mío germanófilo o más bien germanizado, me hacía notar la admirable disciplina con que el pueblo alemán ha sabido ahogar durante cuarenta años sus disensiones intestinas, si es que las tiene, en aras del engrandecimiento de la patria. "Vea usted—me decía—mientras en Francia y en Inglaterra han estado a punto de llegar a la guerra civil, los unos por el *affaire* Dreyfus y los otros por el *home rule* de Irlanda; mientras franceses e ingleses y rusos no han hecho sino disputar en necias disputas interiores, civiles, y proclamar a los cuatro vientos los males de sus patrias respectivas, los alemanes sacrificaban sus reivindicaciones políticas al propósito de ejercer su hegemonía en el mundo."

"Favorecer las industrias alemanas es no sólo perjudicar sus propios intereses, sino también los de la raza latina en general. Porque de este modo se estimula la producción de lo malo y se fomenta indirectamente el militarismo, enemigo acérrimo de esos nobles ideales por los cuales han derramado tantas veces su sangre los países de habla española y portuguesa." J. R. Pérez.

Y a mí, al contrario de mi amigo, me parece ver en eso mismo la más clara prueba de la superioridad cultural de los ingleses, rusos y franceses sobre los alemanes. El que el *affaire* Dreyfus hubiese roto por algún tiempo la unidad moral de Francia—esa unidad tan pronto y tan noblemente rehecha ante el peligro y el enemigo comunes—no es sino una prueba de la superioridad espiritual del pueblo francés, de su respeto por la personalidad humana. Un pueblo que así discute la falibilidad de los fallos de un tribunal militar y que rechaza las viciosas aplicaciones del peligrosísimo principio de *salus populi suprema lex est*, es muy superior a un pueblo de espías. Cierto es que el último y más bajo grado de abyección a que un pueblo puede rebajarse es convertirse en un pueblo de espías.

Mal patriota, muy mal patriota será quien no sienta en vivo los humanos límites del patriotismo; cómo le limitan de un lado el respeto a la individualidad y de otro el respeto a la Humanidad. Un caso como el de ese desgraciado alemán que, habiendo sido profesor en un instituto de enseñanza inglés, se va a los Estados Unidos a maldecir y calumniar al pueblo que le ha mantenido y honrado, no es un caso que honre a pueblo alguno. Más bien demuestra que de la misma madera se hacen el tirano y el esclavo. Para eso no valía la pena de haber inventado aquello del *Welkbürger*. Y ello parece dar la razón a aquel dicho que se atribuye, no sabemos con qué razón, al difunto rey Eduardo VII., que dicen que decía de su sobrino, el Kaiser, que no era un *gentleman*. Diríamos más bien un hombre, un hombre hecho y derecho, entero y verdadero. Y es que esos hombres, por empeñarse en superar a los otros, en ser sobrehombres—o *Uebermenschen*, pues esto es, gracias a Dios, intraducible—se han quedado en alemanes. Por querer encaramarse sobre lo genérico se quedan en lo específico. Lo que no está mal a un pueblo de especialistas.

Tiene razón G. K. Chesterton cuando en sus "Cartas a un Viejo Garibaldino," nos dice que tenemos que defender, contra esa pretendida raza superior, hasta nuestras querellas y disensiones íntimas, y sostiene que nunca fueron los pueblos más verdaderamente grandes que cuando lucharon dentro de sí. Como nunca es más grande un individuo que cuando riñe

empeñadas batallas en el palenque de su propia conciencia. Ya me temía yo que todo aquello del juego íntimo de las contradicciones de Hegel —uno de los padres espirituales del imperialismo germánico — no era más que puro artificio dialéctico. Del mismo modo que no es sino pura pedantería el pesimismo de Schopenhauer. Para lo que basta fijarse en que este egoísta burgués prusiano que pretendió pesar los dolores, para cotejarlos con los placeres, como se pesa patatas o bombas, no sintió nunca el tedio, el terrible tedio que atormentó a un Leopardi, a un Jenancour, a un Mathew Arnold. El burgués prusiano no sintio más que el dolor.

Sería terrible cosa que ese pueblo de presa, unido y unificado para lanzarse sobre los demás, lograse su propósito de dictar al mundo la diferenciación del trabajo social y organizar a Europa, que, según el profesor Ostwald, está por ser organizada y, naturalmente, por ellos. Y organizar el mundo a la alemana sería, ¡ claro está ! convertirlo en una máquina. " La tarea general de la civilización consiste en obtener para las energías que hay que trasformar, coeficientes de trasformación lo más ventajosos posible." De esta manera tan elevada define el progreso el mismo profesor Ostwald, en el capítulo último de su obra *La Energética*. El criterio es del más grosero materialismo—él diría monismo—de fines del siglo XIX.

No, la unidad de un pueblo de presa no demuestra la superioridad moral de ese pueblo. Es la disciplina de una partida de bandoleros. . . . . El lector que haya leído la *Historia de Grecia*, de Jorge Grote, recordará, sin duda, la noble, la nobilísima defensa que este liberal inglés hizo de la democracia, y aun de la demagogia ateniense, frente a los que la vilipendiaban para exaltar al espartanismo.

No, el hormiguero, por muy perfecto que sea, no es un ideal humano. Y si un alemán, el profesor Natorp—¿ pero es que hay alemán conocido que no sea profesor en algo, siquiera en milicia ?—ha dicho que el individuo no es, como el átomo, más que una abstracción, nos ha enseñado con ello que aquel, Yo con letra mayúscula de Fichte y aquel Unico de Max Hirver, no fueron más que abstracciones. Y donde no se siente la individualidad absoluta, el valor supremo del alma humana individual, no cabe sentir la humanidad tampoco. Para sentir la Humanidad sobrepujando y abarcando y limitando, al sobrepujarlas y abarcarlas, a las patrias y naciones, hay que sentir la individualidad, limitando también a las patrias y naciones.

No, no veo la grandeza moral de un pueblo que limita sus libertades políticas y acalla sus íntimas disensiones para mejor prepararse a dominar a otros pueblos.

Y en cuanto a ese galimatías de pueblos superiores e inferiores, no estará de más recordar aquella sentencia de Roberto Browning en su *Bishop Blougram's Apology*, cuando decía :

> *Ah, the earth's best can be but the earth's best !*

No, no puedo admirar la tan celebrada disciplina germánica con su *verboten !* por dondequiera. La admiraría si respondiese a un sentimiento de íntima satisfacción, pero respondiendo al deseo de hacerse el pueblo fuerte hacia fuera, para contra otros pueblos, no la encuentro admirable, sino simplemente inhumana e inmoral.

Y hasta por el aspecto estético. No se puede ni se debe vivir en la expectativa y aguarde del hartazgo del triunfo de pasado mañana ; hay que vivir el día que pasa. Y los franceses mientras duró el *affaire* Dreyfus, y los ingleses en sus luchas por las reformas fiscales de Lloyd George y el *home rule* irlandés, y los rusos en sus debates de la Duma, han vivido y se han exaltado y han forjado sus individualidades.

Tiene razón G. K. Chesterton al decir que en las revoluciones intestinas es donde muestran los pueblos su grandeza moral. El pueblo que no lucha consigo mismo no progresa moralmente como pueblo. Acaba por convertirse en una máquina en manos de una ciega oligarquía de tiranuelos.

No, la unanimidad no es siempre un bien. Unánimes quiere decir que no tienen más que una sola y misma alma, y una sola y misma alma para todos los individuos de un pueblo no puede ser más que un alma genérica, un alma abstracta. Robinson Crusoe solo me parece moralmente mucho más grande que todo un pueblo de presa unánime. El fin moral de una nación es hacer hombres, el de España hacer españoles, el de Inglaterra ingleses. El fin moral del universo es cada hombre ; eres tú, lector.

Aquí, en España, nada se desprecia más que al delator, al sicofante, aunque delate en pro del bien público. Un pueblo de espías es lo más bajo que cabe en el orden moral.

INGLATERRA Y AMÉRICA (ENTREVISTAS). POR DON MAXIMILIANO ATTIAS, autor de ***Así se anuncia*, *El perfecto vendedor*, *La Europa sangrienta***; etc.

—¿ Qué piensa Ud. de los productos ingleses ?,—me preguntó el editor de BEAMA. Deseo conocer su opinión franca y sincera, sin ninguna de esas evasivas de que tanto usan los latinos para no decir en remate gran cosa y no comprometerse.

—Prefiero contestarle narrándole un recuerdo de mi niñez: En una de las visitas que solía hacer con mi madre a los establecimientos mercantiles, la vi examinar los cuchillos que le mostraba el vendedor y decidirse por los que llevaban este rótulo: MADE IN SHEFFIELD. Movido por la curiosidad, no esperé a que saliéramos del almacén para preguntarle el significado de dichas palabras, las cuales, a mi entender, encerrarían la clave del misterio.

—Hijo querido,—me respondió,—cuando aprendas inglés lo sabrás.

Dos años después principié a estudiar el sintético idioma de Shakespeare, y no tardé en descubrir, con inmenso placer, la solución del acertijo inglés. Corriendo hacia mi madre, exclamé lleno de alegría: " Made in Sheffield. . . Fabricado en Sheffield . . . ! "

Pero la verdadera razón que determinó la preferencia de mi madre, aquella que la indujo a elegir dos de entre unas quince muestras, no la comprendí sino varios años después, al observar que tales cuchillos habían prestado grandes y continuos servicios y aun seguían prestándolos como el día de su compra. . .

Artística vista del Niágara, en la cual se destaca la enérgica y varonil figura del Doctor S. García Uriburu, conspicuo abogado de palabra fácil y persuasiva, y dignísimo cónsul general de la República Argentina en el Reino Unido.

Luego para mi madre esas palabras eran símbolo de superioridad, y el solo hecho de que el nombre de una población inglesa estuviese estampada sobre un artículo era suficiente garantía de excelencia. .

Lo mismo me sucedía a mí más tarde. En Buenos Aires compraba yo trajes ingleses, botines ingleses, sombreros ingleses . . . , aunque costaran más que los de otra procedencia, porque, me decía, lo bueno es barato a cualquier precio y así es positiva economía el comprarlo.

Nunca he tenido razón para arrepentirme de semejante conducta ; antes bien, la tengo

para persistir en ella, pues géneros escoceses comprados en la Argentina hace 4 ó 5 años continúan sirviéndome como el día de estrenarlos.

II.

—¿ Cree usted—preguntó el editor,—que esa sea la opinión de una mayoría inteligente de los latinoamericanos ? ¿ Juzga Ud. que los portugueses, españoles y americanos sensatos piensen de igual modo ?

—Sólo puedo contestarle que conozco a varios españoles y americanos que antes de regresar a su país llevaron consigo gran provisión de artículos fabricados en el Reino Unido, y que muchos de ellos siguen encargando su ropa a sastres londinenses. . . .

—¿ No cree Ud. que la opinión de ilustrados ingenieros españoles, portugueses y latinoamericanos, y la de sus respectivos cónsules acreditados en Londres, ayudaría muchísimo a formar mejor idea del concepto que inspiran los productos ingleses, particularmente los de ingeniería eléctrica y mecánica ? Semejante opinión será utilísima para los que en dichos países piensan comprar máquinas, porque ella les mostrará imparcialmente hasta qué punto puede confiarse en los artículos de la Gran Bretaña y en qué grado satisfacen al comprador.

—Va Ud. acertado ; pero hay dos obstáculos insuperables. En primer lugar, la escasez de tiempo, pues dentro de pocos días tiene que salir el presente número de BEAMA ; y en segundo, la delicada situación de los cónsules, que, como neutrales, deben callar sus simpatías hacia los aliados, por grandes que sean. Uno me dijo *en privado* : " Si yo pudiera mandar en mi tierra, no dejaría libre paso más que a las máquinas inglesas, por ser las que honradamente cumplen con su misión. Y así como se dictan leyes para combatir plagas, yo las dictaría para combatir la de las máquinas inferiores, que tientan al desdichado comprador con su bajo costo inicial, para luego ocasionarle pérdidas considerables . . ." Pero estoy seguro de que jamás me permitiría él relacionar su nombre con esta declaración.

—Sin embargo, Ud. es hábil y podrá obtener datos preciosos. Además, como el lector latino es de imaginación despierta, en lo poco que digan aquellas personalidades descubrirá lo que por diplomacia se calla. . . .

> 81, Cannon Street,
> E.C.
> 21 de Junio de 1916.
>
> **Señor :**
>
> **En contestación a su atenta comunicación de 9 del presente me cabe manifestarle a Vd que en Bolivia se recibe con simpatía a todos los extranjeros que van allí, bien sea a establecerse en el comercio o como viajantes y que siempre se ha dado preferencia a los artículos fabricados en el Reino Unido de la Gran Bretaña por considerarlos siempre de muy buena calidad.**
>
> **De Vd muy atto y S.S.**
>
> Pedro Suarez

Carta del reputado ingeniero Don Pedro Suárez, Teniente coronel de artillería, ex diputado boliviano, conferencista de nota, y actualmente cónsul general de Bolivia en la Gran Bretaña.

III.

Al día siguiente de esta conversación, a las 10 en punto de la mañana, me lancé a oficinas particulares y consulados, y por tres días consecutivos no hice otra cosa que recoger informes. . . . Con placer manifiesto que en todas partes he hallado calurosas palabras de simpatía hacia la Gran Bretaña y sus productos, y en multitud de casos se me ofrecieron copiosas estadísticas para probar que las máquinas del Reino Unido gozan de una reputación envidiable. Algunos fueron más lejos y me dieron consejos amistosos acerca de los medios más adecuados para desarrollar las industrias británicas en sus respectivos países, y se brindaron a prestarme toda la ayuda posible.

Uno de los cónsules me refirió este suceso: " Una gran fábrica de termómetros del Reino Unido exportaba grandes cantidades a . . . , y sus productos llegaron a preponderar de tal suerte, que ya nadie quería otros. Casas alemanas, ansiosas de estimular la venta de sus termómetros y no viendo otro medio de realizarlo que la falsificación, no vacilaron en sortear la ley y dedicarse a un negocio inmoral . . . (¿ Qué otra cosa puede esperarse de los que matan a inocentes criaturas y colocan a venerables ancianos delante del cañón para que sirvan de protección a sus tropas ?) En resumen, pronto los fabricantes ingleses empezaron a recibir quejas, y por el cabo sacaron el ovillo; es decir, descubrieron que se falsificaban sus artículos. Recurrieron a mí solicitando ayuda, y yo tuve el placer de asistirlos en todo lo posible y suministrarles recomendaciones para el Gobierno de mi patria, donde se les hizo justicia, como a todos los comerciantes honrados que caen bajo las garras de los malvados." Al concluír este relato me ofreció, como testimonio de que sus palabras estaban inspiradas en la verdad pura, una misiva de introducción para los fabricantes, a fin de que fuera a entrevistarlos y convencerme por mí mismo.

Retrato del simpático y activo cónsul general de Chile en el Reino Unido, Doctor V. Echeverría, ex profesor de economía política en la Universidad Católica de Santiago, abogado de relevantes méritos y estimable conferencista.

IV.

En las visitas a los cónsules he recibido una gratísima sorpresa, cual es su notable preparación. Había oído decir con frecuencia que los puestos diplomáticos eran hijos de influencias extrañas, y que así los desempeñaban personas más afortunadas que competentes; pero confieso ingenuamente que nunca he visto juicio más errado. Un cónsul como el de la República Argentina, que en un momento presenta gran cantidad de números relativos a importaciones y exportaciones, que menciona los cientos de millones de libras invertidas por los ingleses en la próspera república del Plata, que explica en un castellano armonioso la composición del pueblo de Mitre y Sarmiento y saca de allí atinadas deducciones filosóficas, muy favorables por cierto a las naciones aliadas; no es seguramente una persona ordinaria: antes bien, es un representante culto, honrado, del cual puede justamente enorgullecerse su patria. Un cónsul como el del Brasil que cita número sobre número respecto de ferrocarriles, etc., y habla de proyectos, y muestra oportunidades para los industriales hábiles, es indudablemente persona que puede desempeñar a conciencia su delicado cargo. Un cónsul como el de Chile o el de Bolivia, en fin, que dan conferencias en importantísimas corporaciones científicas, son hijos cariñosos de la América que cumplen con el sagrado deber de ayudar a la madre patria en su desarrollo e influencia. . . .

Pero la misma cantidad de materiales y de informes que me han suministrado es prueba elocuente de mi aserto; es refutación incontrovertible del estúpido prejuicio a que me he referido y que no sé cómo haya encarnado en ciertos espíritus. Tan abrumador es el número de datos que he recogido, que en este artículo sólo me limito a decir dos palabras generales sobre el concepto que inspiran los productos ingleses en los países de habla española y portuguesa, reservando para el próximo número de BEAMA informes más concretos. Acaso sea necesario escribir artículos especiales, referentes a la Argentina, Bolivia, Colombia, Chile, España, etc.

V.

Modificando una de mis anteriores objeciones al editor de BEAMA, me decía yo esta mañana: " Siempre habrá quienes, renunciando a pompas retóricas y vanos formalismos, enarbolen el estandarte de la verdad llana y sencilla, y lo exhiban sin miedo a los cuatro vientos. . . . Ellos, como impetuosas aguas,

barren todos los obstáculos que obstruyen su camino. . . .

" ¿ Cómo no admirar la conducta varonil de estos nobles ciudadanos, que prefieren declarar sin ambages su pensamiento a envolverlo en mil sutilezas que les faciliten una salida en caso de dificultad ? . . . Unamuno, fustigando rudamente el idioma vasco en el propio Bilbao, y arremetiendo duramente contra los vicios gallegos en la propia Coruña, y atacando a los periodistas delante de un auditorio mayormente compuesto de ellos, resulta simpático hasta para los mismos a quienes combate : tan grande es el poder de la augusta verdad. . ."

Motivaban estos conceptos la categórica respuesta del distinguido ingeniero don Pedro Suárez, quien sin mañosos artificios declara que " en Bolivia *siempre se ha dado preferencia* a los artículos fabricados en el Reino Unido de la Gran Bretaña por considerarlos *siempre* de *muy* buena calidad." Realza el valor de estas palabras el hecho de que su autor es perito en su profesión.

Ha despertado igualmente mi admiración la formal contestación del estimado y popular cónsul argentino, el doctor Sergio García Uriburu, el cual no vacila en afirmar que en la *Gran República del Sur* " los productos ingleses ocupan lugar prominente." Y apoyando su aserto en los hechos, como buen abogado que es, me mostró un libro de estadística en el cual la Gran Bretaña figura a la cabeza en lo relativo a máquinas, etc. " Es indudable, continuó, que si se favorece tanto a este país no es por mero capricho. . . ." No, no es por mero capricho, sino por la insuperable calidad de sus productos.

Escribe con sobrada razón don Jorge de Campobello, en el artículo que aparece en otra parte bajo el título de " La Ingeniería Eléctrica Inglesa en el Mundo " :

" Podrá alguno dejarse tentar por los bajos precios de fabricantes extranjeros y comprar sus máquinas, pero no tarda en descubrir que la economía es aparente y antes constituye una fuente de pérdidas ; y amargamente desconcertado se dirige hacia la Gran Bretaña salvadora, cuyos productos jamás dan motivo para descontento . . ." Pero yo deseo ardientemente evitar semejantes casos, y juzgo que este artículo y los que escriba después, sirviendo una causa honrada y justa, harán mucho bien a mis hermanos de habla española y portuguesa. Es tan fuerte la tentación de los bajos precios, que cae uno a menudo en sus garras, no obstante amistosos consejos : de ahí que por grande que sea la popularidad de las máquinas de origen británico nunca será superfluo acumular hechos y pruebas y publicar juicios de personas de indiscutible imparcialidad : sólo así podrá contrarrestarse aquella maléfica influencia.

Antes de cerrar estas líneas habría deseado reproducir la brillante conferencia dada recientemente por el erudito doctor Echeverría en el King's College, Universidad de Londres ; pero como el espacio no me lo permite, me veo obligado a resumirla en estas dos palabras : es un himno a la grandeza del pueblo inglés y a la excelencia de sus máquinas !

VI.

He visitado notables ingenieros de varios países y todos me han dicho que en su patria los productos británicos son estimados y preferidos, y brindádome datos que lo prueban concluyentemente.

Hé aquí una declaración típica :

" Sí, las máquinas inglesas han gozado y gozan siempre de excelente reputación en mi patria. . . . Tan alto concepto nos hemos formado de la ingeniería del Reino Unido, que mandamos a nuestros hijos a estudiarla en este país, así como los enviamos a estudiar música y pintura en Italia, y medicina en París. Estamos persuadidos de que la Gran Bretaña es el lugar más apropiado para obtener una sólida e indisputable preparación en aquel ramo del saber humano, en el cual tanto sobresalen los nobles hijos de la simpática Albión. . . . Y claro está que si tanto estimamos su ingeniería no menos hemos de apreciar sus máquinas. Es más : otras naciones venden las suyas asegurando que son *como las inglesas*, pero más baratas debido a economía en su fabricación y a un moderado deseo de lucro.

El número de ellas vendido en mi suelo natal por los ingleses es sin duda abrumador, pero podía aumentarse considerablemente. . . . Los ingleses deben imitar a sus hermanos de la América del Norte y abandonar la actitud que hasta la fecha los ha caracterizado. . . . En vez de contentarse con saber que sus productos son excelentes y confiar en que todo lo bueno se impone por sí mismo, deben lanzar estas verdades a los cuatro vientos por medio de propaganda activa e inteligente ; publicar sus catálogos en castellano, dar los pesos, medidas,

etc., corrientes en España y la América latina; e interesar en su empresa a los ingenieros de mérito, quienes, como personas honradas, contribuirían, si se les ayudara, a difundir lo que seguramente ha de beneficiar a su patria."

—¿Ha visto Ud. el informe presentado recientemente por el ingeniero municipal de Shanghai?—pregunté a mi amable interlocutor, presentándole un ejemplar del mismo.

Después de leerlo, contestó:

—Pero este es un grano de sal. . . . Si los fabricantes del Reino Unido llevaran a cabo una investigación extensa, descubrirían con placer que semejantes casos abundan. . . . Yo puedo citarle varios ocurridos en mi tierra. . . . Pero me disculpará Ud. que hoy no lo haga, porque tengo que despachar muchos asuntos, algunos de urgencia.

Y dándome un estrecho apretón de mano, prometióme más infomes para dentro de poco. . .

En todas partes he hallado la misma simpática acogida.

LA PROTECTORA DE LA LIBERTAD

"GENEROSA es siempre la idea de la libertad para esta noble nación inglesa, protectora natural de todos los proscritos y que, por su parte, no proscribe a nadie: ¡doble gloria a que ojalá lleguen algún día todas las naciones! . . ."

D. EUGENIO DE OCHOA

INSTALACIONES INDUSTRIALES MOVIDAS POR ELECTRICIDAD. POR FRANK WALKER.

(*Nota.—El siguiente artículo es un extracto del que se publica en inglés en la página* 136, *allí encontrará el lector las ilustraciones que se mencionan aquí.*)

Generalmente hablando, el propietario o director de un taller es muy cuidadoso en la elección de su motor principal, pero no siempre trata de que las disposiciones para la trasmisión de energía sean lo más económicas posible. Debe tenerse muy en cuenta que el objeto principal de un motor no es mover líneas de árboles, correas, engranajes, etc., sino las máquinas esenciales para objetos fabriles.

Acaso la mayoría no tenga idea de cuánta es la energía que se desperdicia en las disposiciones de trasmisión; experimentos prolijos demuestran que estas pérdidas alcanzan frecuentemente a 50% y en algunos casos a muchísimo más.

Eliminación de pérdidas.—Las pérdidas en la trasmisión mecánica de la energía se deben principalmente a la fricción de los apoyos, la flexión de correas y cuerdas, y al deslizamiento de correas y cuerdas de la polea y de las diversas clases de engranajes. Las pérdidas son mayores cuando se emplean intermitentemente un gran número de máquinas movidas con árboles, porque los desperdicios en las trasmisiones ocurren todo el tiempo que funciona la máquina, aunque no se esté efectuando ningún trabajo provechoso. De aquí que la proporción de energía o trabajo útil producidos por las máquinas puede ser, en el curso de un día, muy pequeña, en algunos casos no más de 20% del total de energía suministrado por la máquina.

Aumento del rendimiento.—El rendimiento de una máquina depende principalmente de dos causas, que son:

1a. Su regularidad cíclica, o sea la regularidad durante cada revolución; y

2a. La conservación del mayor promedio de velocidad adecuada a la clase particular de trabajo que se está efectuando.

La velocidad de la revolución de la máquina guarda relación fija con la del motor principal; pero cualquier irregularidad cíclica en éste aumenta en el engranaje de la trasmisión mecánica.

La influencia de estas causas aparece en las curvas de las figuras 2 a 12.

La figura 3 es un registro del tacómetro, referente a una máquina condensadora compuesta, acoplada, de 500 caballos de vapor británicos, que funciona a razón de 75 revoluciones por minuto; la irregularidad cíclica es menor de 0.5 por ciento.

La figura 4 es un registro semejante relativo a una máquina condensadora de doble palanca oscilante y 800 caballos de vapor británicos, que funciona a una velocidad de 31 revoluciones por minuto. La irregularidad cíclica en este caso es como de 3%.

La figura 5 es el registro de un motor de gas horizontal de 40 c. de v. b., que funciona a 176 revoluciones por minuto. La velocidad varía en el registro debido al modo de manejar; la irregularidad cíclica es de 6% aproximadamente.

La figura 6 enseña el registro de un motor de gas vertical, acoplado, de 750 c. de v. b., que funciona a 200 revoluciones por minuto. La irregularidad cíclica es de 0.5 por ciento, y la velocidad es casi constante en todo el registro.

Comparada con los motores principales representados por los registros precitados, la turbina de vapor resulta superior tanto en lo que se refiere a regularidad cíclica como a constancia de velocidad durante largos períodos de funcionamiento.

La figura 7 indica hasta qué extremo se aumenta o exagera la irregularidad cíclica de una máquina motriz, en la trasmisión por correas, cuerdas, engranajes y árboles.

El registro A es de una máquina horizontal compuesta, de 300 c. de v. b., en la cual la irregularidad cíclica es de 1½%, aproximadamente. La energía se trasmitió desde la máquina al árbol principal por medio de cuerdas, y el registro B se ha tomado desde este árbol, a unos 90 pies de la polea motriz.

Desde el punto en que se ha tomado el registro B la energía se trasmite por medio de engranaje cónico a un árbol vertical de unos 50 pies de longitud, y de allí por medio de otro engranaje cónico a un árbol horizontal de unos 40 pies de longitud. El registro C fue tomado desde este árbol.

Se observará que en este punto la irregularidad cíclica es como de 15%, o sea 10 veces la de una máquina motriz.

Desde el punto en que se tomó el registro C, se movía la maquinaria de un taller de hiladura de algodón; pero sustituyendo un motor de corriente alternada a la trasmisión mecánica, la irregularidad cíclica se redujo de 15 a 2½%, según lo muestra la figura D.

La figura 8 es un registro de un taller de hiladura de algodón situado a unos 185 metros de la máquina motriz, y la energía se trasmite por medio de ruedas dentadas, ruedas cónicas y dos correas de trasmisión horizontales y una vertical. La irregularidad cíclica de la máquina es de menos de 0.75 por ciento, y la de la sala de filatura es, según muestra la figura 8, de 12%.

La figura 10 indica la variación de la velocidad, en un día de trabajo, de una máquina que mueve un bocarte. Importa tener presente que la mayor reducción de velocidad se verifica cuando la carga es mayor, originando así una notable disminución en la capacidad productiva de la fábrica.

Ventajas de la trasmisión eléctrica.—La velocidad de un electromotor es casi independiente de la carga. La variación entre "ninguna carga" y carga de 25 ó 50% sobre la máxima normal del motor, no pasa de 5% aproximadamente. Para sacar la mayor ventaja de la trasmisión eléctrica respecto a la regularidad de trasmisión y máximo de rendimiento, es necesario adoptar la *trasmisión individual,* lo cual significa que cada máquina debe estar movida por un motor independiente. Esto no es siempre posible debido al gasto, pero considerando todos los factores, generalmente es más provechoso mover con motores independientes las máquinas principales, sobre todo aquellas en que se requieren numerosos grados de velocidad, y en grupos convenientes las máquinas más pequeñas, en las cuales no se desea gobierno de velocidad. Cuando la naturaleza del trabajo exige muchas velocidades diferentes, la trasmisión individual ofrece ventajas excepcionales, en cuanto la velocidad de un motor puede variarse ampliamente por medios sencillos, y en muy leves graduaciones de velocidad, tal que la máquina funcione a la velocidad más apropiada al trabajo y así el máximo rendimiento pueda obtenerse siempre. Esto no es posible cuando las máquinas están movidas desde los árboles.

En muchos casos en que se ha adoptado la trasmisión eléctrica, el rendimiento ha

experimentado un aumento de 5, 10 y aun 25%, según el carácter del trabajo.

Motores de corriente continua y alternada. —Cuando se necesitan numerosos grados de velocidad, el motor de corriente continua presenta ventajas, pues se puede gobernar sencilla y económicamente. Su desventaja consiste en que el mecanismo de la escobilla y los conmutadores, que son las principales partes que se gastan, requieren cierta atención.

El motor de corriente alternada es algo más sencillo que el de corriente continua y también más robusto y permite mayor sobrecarga y más descuidos. La ventaja importante de la corriente alternada es que puede transformarse a una presion más alta o más baja por aparatos sencillos y estacionarios.

Suministro de energía por empresas públicas e instalación propia.—Para resolver qué conviene más, si producir su electricidad o tomar corriente de una empresa pública, hay que considerar mayormente el costo y facilidades para obtener energía eléctrica, el precio del combustible, la naturaleza del trabajo y las horas de funcionamiento. Para las horas ordinarias de trabajo, 8 ó 10 por día, es en muchos casos más conveniente utilizar un servicio público, lo cual ofrece la ventaja de que uno puede empezar en pequeña escala y aumentar gradualmente el uso de la electricidad. Además, el espacio que ocuparía la instalación generadora podría utilizarse con más fruto en operaciones fabriles. Otra consideración es que tomando corriente de una empresa pública el propietario o director ahorra el tiempo que de otro modo habría consagrado a ese problema, que en verdad es diferente de los que presenta su ramo, y así se halla en condiciones de concentrar la atención sobre su negocio.

En los casos en que las operaciones fabriles se verifican de día y de noche, con frecuencia es más económico producir uno su electricidad, sobre todo cuando se requiere vapor para otros fines que producción de energía. Así, a menudo se requiere vapor para talleres químicos, fábricas de papel, cervecerías, y otras industrias: de modo que son esenciales calderas de vapor. Si puede usarse vapor de baja presión para este fin, en muchos casos es posible emplear el vapor de escape de las máquinas, y así efectuar considerables economías.

Elección de la planta generadora.—Cuando no puede obtenerse electricidad de un establecimiento público, la energía debe necesariamente producirse en el local propio, y entonces uno de los principales problemas consiste en cuál es la clase de motor principal más adecuado al objeto.

Turbinas hidráulicas.—La elección de turbinas hidráulicas para suministrar energía depende casi por completo del abastecimiento continuo de fuerza hidráulica. Durante algunas épocas del año hay una provisión amplia de agua, mientras en otras la corriente es muy limitada, y si uno necesita la energía hidráulica, le es indispensable basar sus cálculos sobre la corriente mínima.

Debido a la inercia del agua cuando corre por tubos, es muy difícil el gobierno de la velocidad, y cuando la continuidad o constancia de ésta es requisito esencial, la manera de gobernar es algo costosa y complicada.

Máquinas de vapor.—Al decidir acerca de la potencia de una máquina de vapor debe considerarse cuál es el *máximo* de energía pedido y además cuál es la necesaria energía *habitual*, de modo que la máquina pueda suministrar su mayor rendimiento con la energía que ordinariamente se requiere, o casi.

Turbinas de vapor.—La turbina de vapor se considera en la actualidad como superior a cualquier otra máquina motriz, pero no es económica para potencias menores de 500 caballos de vapor.

Cuando se tiene vapor de baja presión, o cuando además de la energía se requiere vapor para calentar, secar, hervir o evaporar hay un gran campo de acción para turbinas de presión baja o mixta, que son muy económicas.

Para obtener la economía máxima de las turbinas, es esencial que funcionen conforme al principio de condensación. Esto necesita, como es natural, una amplia provisión de agua para condensar.

Motores de gas.—Motores de gas horizontales pueden conseguirse en la actualidad hasta de 100 caballos, con un cilindro. Para mayores potencias se requiere generalmente más de un cilindro. Sin embargo, en este último caso se usan mucho ahora motores de gas verticales. Estas máquinas ocupan poco espacio, relativamente al que requieren las horizontales. Los motores de gas verticales se construyen por lo regular con varios cilindros y

de este modo se puede obtener una gran regularidad de velocidad. Al pedir motores de gas, empero, es importante tener presente que, contrariamente a lo que sucede con la máquina de vapor, casi no tienen capacidad para sobrecarga.

Motores de Diesel.—Los motores de Diesel funcionan con aceites pesados, tales como residuo de petróleo, residuo de aceite de esquisto, petróleo crudo, o casi cualquier aceite filtrado. Su economía depende mayormente de la baratura del combustible consumido. Tales máquinas se construyen ahora en modelos adecuados para funcionar con alquitrán, que se produce en grandes cantidades dondequiera que haya hornos de gas y cok. Cuando se emplea alquitrán, se usa parafina para encender, y el consumo de ésta equivale como a 5% del consumo a plena carga del combustible.

PRUEBA IMPARCIAL Y CONVINCENTE DE LA SUPERIORIDAD DE LAS MÁQUINAS BRITÁNICAS.

Un reputado ingeniero municipal refiere las ENORMES PÉRDIDAS ocasionadas por turboalternadores alemanes y el ÉXITO LISONJERO obtenido con los de origen británico.

Las máquinas fabricadas en la Gran Bretaña han conquistado en el mundo entero una reputación envidiable por su bondad y duración.

Prueba incontrovertible de la excelencia de los productos británicos son los hechos siguientes, que constan en el Informe presentado por el ingeniero electricista municipal don T. H. Aldridge al Consejo Municipal de Shanghai:

En la Estación Generadora Eléctrica de dicha ciudad se instalaron al principio máquinas de fabricación británica (turboalternadores de vapor con una capacidad de 500 á 1000 kilovatios), con tan buenos resultados que algunas han funcionado sin el menor tropiezo por más de 9 años.

Hace unos dos se resolvió instalar asímismo turboalternadores alemanes de 2000 y 5000 kilovatios, y se hizo el pedido a la A. E. G. de Berlín.

Poco después de haberse instalado las máquinas se observaron grandes defectos, y en uno de los MOMENTOS MÁS CRÍTICOS el 66% de la instalación de turbinas, se desorganizó.

Obedecía esto a defectos mecánicos en las turbinas, originados por el empleo de metal inadecuado en el acabado, e imperfecciones eléctricas en los alternadores y transformadores, que exigían reconstrucción parcial.

Una de las turbinas de 5000 kilovatios destruyó el acabado de una rueda, y al tiempo de escribir estas líneas sigue funcionando aún en el mismo estado, absorbiendo en caballos de vapor por hora más de 50% de lo garantizado por los fabricantes alemanes.

El cuadro siguiente, formado con los datos del precitado ingeniero municipal, muestran que el costo anual de conservación y reparación de las turbinas alemanas excede ENORMEMENTE el de las máquinas de procedencia británica:

Procedencia	Capacidad en kilovatios	Años en uso	Costo anual comparativo de conservación y reparación	Costo en pesos oro
Británica, No. 1 ...	600	8	10	85
,, ,, 2 ...	600	8	13	115
,, ,, 3 ...	500	5	24	215
,, ,, 4 ...	1000	9	27	235
,, ,, 5 ...	1000	8	28	245
,, ,, 6 ...	500	5	30	265
Alemana, A.E.G., No. 1	2000	1 año y 9 meses.	150	1325
Alemana, A.E.G., No. 2	2000	1 año y 9 meses.	180	1600

Fácilmente se comprenderá que si tan serios inconvenientes tienen las mejores máquinas de origen alemán, ***manejadas bajo la dirección de hábiles ingenieros***, han de ser notablemente mayores cuando el personal no sea tan competente.

Convencido de la SUPERIORIDAD DE LAS MÁQUINAS ELÉCTRICAS BRITÁNICAS SOBRE LAS ALEMANAS, el Consejo Municipal de Shanghai pidió recientemente a una casa inglesa sendos turboalternadores de 5000 y 10.000 kilovatios.

Despréndese claramente de todo lo arriba expuesto que es falsa economía comprar máquinas alemanas porque su costo inicial sea más bajo que el de las británicas; aquéllas (*las alemanas*) resultan más caras a la larga, como todo lo de calidad inferior.

IBERO.

VOL II No. 3. JULY 1916

CONTENTS

THE BEAMA JOURNAL

TRADE AS AN ALLY OF PRINCIPLES.

We still hear it stated in this country by certain " pacifists " that the war was caused by trade rivalry. In Austria-Hungary and Germany prominent statesmen have lately reiterated the old tale that the war was due to England's jealousy of Germany's commercial success. This, of course, is merely dust thrown in the eyes of the people so that they may not see the culpability of the military statesmen who at present control the destinies of the Central Powers.

As proof of their theory pacifist socialists point triumphantly to the Economic Conference of the Allies in Paris, to the policy that is being prepared both by the Allies and the Central Powers* in regard to Tariffs, and to the trading-with-the-enemy enactments that have been passed by the legislatures in Great Britain, the Colonies and the Protectorates.

Conclusions of this sort are arrived at by very shallow thinking. The pacifist's ideal for the world is to reduce it to an anæmic, somnolent state, in which there are no assertive individuals or nations who have any principles or ideas worth fighting for or defending. He would, in truth, like to ignore the function of physical life, to defy the law of competition and to deny the obvious fact that industry and commerce are the basis of every nation's existence. Further, the pacifist does not see that Militarism and Commerce are two absolutely conflicting systems, for though Commerce may be used to feed Militarism, it may be used, also, to defeat Militarism. Can it be disputed that whatever contributes to the support of man's physical life, contributes also to the continuance of man's thoughts, desires and ambitions? It is not industry and commerce that are at fault; it is Man himself! Industry and commerce are the tools of man's desires, and may be used to build the civilization of his choice—a terrible despotism or a beautiful democracy. If the returns from industry and commerce are necessary to create a military machine their withdrawal would reduce the power of the machine.

German commerce is now a symbol of the Prussian state; it was deliberately organized and developed, not in the interests of science or humanity, but to give power to Prussian ideals. This has been so often demonstrated that it would seem unnecessary to repeat it; but the conclusion, though a simple syllogism of logic is avoided by those superficial thinkers who would blame " trade " for all the evils of the world.

The Prussian State is under a military system;
The Prussian State is supported by commerce;
Ergo, the military system depends on commerce and may be defeated by crushing the commerce of the Prussian State.

This little formula is held by so many vindictive, anti-German persons in this country that the pacifist and free-trader scorn to accept its logic. The free-trader replies, " Certainly, you may try to crush Germany in this way, but it is a two-edged weapon—it cuts both ways—and you will injure yourself, perhaps as badly as Germany." By this reply one school of Free Trade economics betrays a selfish, " commercial " and materialistic standpoint. It is true, of course, that exchange of commodities between two nations benefits both, and if the Allies refuse to buy from Germany they will have to forego the advantage of selling to Germany. This might be, however, a deliberate sacrifice, made in order to cripple the power of the German State, now under Prussian military control—a sacrifice offered on behalf of the principles of Freedom and Self-government.

Idealists are no use in the world if they cannot find a method of working toward their Ideal, if they do not see that certain undesirable tendencies in human beings must be eradicated before Free Trade can become a reality; otherwise avaricious, ambitious, unscrupulous traders and statesmen would take advantage of free-trade conditions for their own aggrandisement. Neither the pacifist nor free-trader is willing to sacrifice anything, in the meantime, in order to take us a step nearer to international amity. It is true, also, that many of those who are shouting on the house-tops for a trade-war do

* See the article in this Journal by Frederick Wile.

not realize the sacrifice involved. But it cannot be said that the statesmen of the Allies who are considering the advisability of using this weapon are actuated by motives of commercial greed. This accusation has no justification when the whole circumstances of the war are taken into account. The manufacturers and traders of the Allies were not consulted as to the advisability of entering this war, for it did not concern especially any one class in the country; it was an affair of the nation and it is still and will be for many a day a point of honour for the nation *as a whole* to maintain the national existence and to resist military aggression by any other nation. And we must be unanimous in wishing to use all honourable means to this end.

In concluding his speech at the Economic Conference in Paris, the Belgian Prime Minister said (as reported in *The Times*): "*The Conference has prepared for economic defence, not war, or rather a preservative and beneficent union of the Allies against war.* For two years the spirit of evil had succeeded by masterly organization in placing force in the service of crime. The nightmare had weighed upon the conscience of the world. The Allies are now working to organize and increase their power so as to make it an austere and faithful guardian of freedom, honesty and justice. The sole motive of the Allies is to obtain from the guilty a just expiation of their misdeeds and, for honest States, peace and security."

The Germans have not played fair; they are at war with our modern civilization; they have placed themselves outside the pale of humanity. It is a most dramatic moment in the world with one group of nations in Middle-Europe determined to become self-sustaining, to defy the rest of the world and in no wise to alter their methods which have been condemned by other nations; and the Allies, who have fought the Middle-Europe Empire in arms, are preparing to enter into an Economic Pact to become self-sustaining amongst themselves, so that the Central Powers will have no opportunity of growing rich from the resources of the Allies.

It is almost an idealistic programme that the Economic Conference has drawn up in Paris. It is based on exactly the same motives that induced the Allies to enter the War. But it is a programme that must be carried out largely in times of peace; and when that time comes each nation will naturally be interested in building up her own resources. The recommendations of the Conference do not lay down any details as to procedure, and success in carrying out the purpose of the "pact" will depend upon the co-operation of the Allies and upon a mutual recognition of the varying conditions in the widely separated countries. The adjustment of tariffs as between these countries, as each rightfully seeks to protect its manufactures and national resources, will tax the highest statesmanship in all countries. Within the British Empire alone these problems are tremendously complex. The future on these lines is a matter of experiment. But the stronger and deeper is the intention to develop each nation within the Allied group as far as possible, and to show Germany that the rest of the world does not approve of her present attitude and methods—the more hope of success. A free-trader has suggested a simple way out of the difficulty, *viz.*, to make it a condition of peace that Germany should take down all tariffs and allow goods to enter her Empire free of duty; and, of course, no tariffs should be imposed by the Allies. The objections to this, aside from the practical impossibility of getting all the Allies to agree to it are:—

(1) It would place Germany on an equal footing with other countries, and, considering her ethical and political ideals, this would be dangerous for the rest of the world;

(2) German patriotic sentiment would be strong enough to keep out the goods that for economic reasons she did not want;

(3) Germany has no respect for treaties and does not keep her bargains.

Nevertheless modern Germany will still be a fact in the world after the war. There will remain not only all that she has contributed to civilization in science, organization, industry, music and philosophy, but the nation itself, organized politically, will be there in the centre of Europe. Will that nation continue in its perverse ways blindly following military leaders and lending all its powers to maintain an idol detested by the rest of the world, or will it be possible for it to learn that in order to take a place with other great powers, it must shatter its idol and build according to an ideal common to all humanity? Other nations cannot entirely ignore Germany; they had indeed done this to their detriment. Germany is too powerful

and has used her power too perversely to be ignored. Her measure has now been taken, however, and if the contrast of her ideals and those of other nations is really realized, each of the Allies will resolutely put party policies aside and proceed to reconstruct its internal affairs so that civilization will present a group of nations allied in the defence of nationality, the friendship and reciprocity with which Germany will have to win, and win on honourable terms.

All thoughtful men should study the proposals of the Economic Conference in Paris and consider what practical measures will be necessary in order to carry them into effect, bearing in mind that each nation in the "pact" has special problems of its own which must be solved without forgetting the "bond of necessity" as now recognised by all the Allies. It is no argument against the purpose of these Recommendations that neutral countries will trade with Germany. If the Allies, or even some of them, can make themselves self-sustaining and self-contained, they will consequently keep out of their countries the deteriorating influences of Germany's commercial propaganda, which has always sought influence for political ends.

THE RECOMMENDATIONS.

I.—The representatives of the Allied Governments have met at Paris under the presidency of M. Clémentel, Minister of Commerce, on June 14, 15, 16 and 17, 1916, for the purpose of fulfilling the mandate given to them by the Paris Conference of March 28, 1916, of giving practical expression to their solidarity of views and interests, and of proposing to their respective Governments the appropriate measures for realizing this solidarity.

II.—They declare that after forcing upon them the military contest in spite of all their efforts to avoid the conflict, the Empires of Central Europe are to-day preparing, in concert with their allies, for a contest on the economic plane, which will not only survive the re-establishment of peace, but will at that moment attain its full scope and intensity.

III.—They cannot therefore conceal from themselves that the agreements which are being prepared for this purpose between their enemies have the obvious object of establishing the domination of the latter over the production and the markets of the whole world and of imposing on other countries an intolerable yoke.

In face of so grave a peril the Representatives of the Allied Governments consider that it has become their duty, on grounds of necessary and legitimate defence, to adopt and realize from now onward all the measures requisite on the one hand to secure for themselves and for the whole of the markets of neutral countries full economic independence and respect for sound commercial practice, and on the other hand to facilitate the organization on a permanent basis of their economic alliance.

For this purpose the Representatives of the Allied Governments have decided to submit for the approval of those Governments the following resolutions:—

A.

MEASURES FOR THE WAR PERIOD.

I.—The laws and regulations prohibiting trading with the enemy shall be brought into accord.

For this purpose:—

A.—The Allies will prohibit their own subjects and citizens and all persons residing in their territories from carrying on any trade with:—

1. The inhabitants of enemy countries whatever their nationality.
2. Enemy subjects wherever resident.
3. Persons, firms and companies whose business is controlled wholly or partially by enemy subjects or is subject to enemy influence and whose names are included in a special list.

B.—They will prohibit the importation into their territories of all goods originating in or coming from enemy countries.

C.—They will devise means of establishing a system enabling contracts entered into with enemy subjects and injurious to national interests to be cancelled unconditionally.

II.—Business undertakings owned or operated by enemy subjects in the territories of the Allies will all be sequestrated or placed under control; measures will be taken for the purpose of winding up some of these undertakings and of realizing their assets, the proceeds of such realization remaining sequestrated or under control.

III.—In addition to the export prohibitions which are necessitated by the internal situation of each of the Allied countries, the Allies will complete the measures already taken for the restriction of enemy supplies, both in the mother countries and in the Dominions, Colonies, and Protectorates:—

1. By unifying the lists of contraband and of export prohibition, and particularly by prohibiting the export of all commodities declared absolute or conditional contraband;
2. By making the grant of licences for export to neutral countries from which export to enemy territories might take place conditional upon the existence in such countries of control organizations approved by the Allies; or, in the absence of such organizations, upon special guarantees such as the limitation of the quantities exported, supervision by Allied consular officers, etc.

B.

TRANSITORY MEASURES FOR THE PERIOD OF COMMERCIAL, INDUSTRIAL, AGRICULTURAL, AND MARATIME RECONSTRUCTION OF THE ALLIED COUNTRIES.

I.—The Allies declare their common determination to ensure the re-establishment of the countries suffering from acts of destruction, spoliation, and unjust requisition, and decide to join in devising means

to secure the restoration to those countries, as a prior claim, of their raw materials, industrial and agricultural plant, stock and mercantile fleet, or to assist them to re-equip themselves in these respects.

II.—Whereas the war has put an end to all the treaties of commerce between the Allies and the Enemy Powers, and whereas it is of essential importance that, during the period of economic reconstruction which will follow the cessation of hostilities, the liberty of none of the Allies should be hampered by any claim put forward by the Enemy Powers to most-favoured-nation treatment, the Allies agree that the benefit of this treatment shall not be granted to those Powers during a number of years to be fixed by mutual agreement among themselves.

During this number of years the Allies undertake to assure to each other so far as possible compensatory outlets for trade in case consequences detrimental to their commerce result from the application of the undertaking referred to in the preceding paragraph.

III.—The Allies declare themselves agreed to conserve for the Allied countries, before all others, their natural resources during the whole period of commercial, industrial, agricultural, and maritime reconstruction, and for this purpose they undertake to establish special arrangements to facilitate the interchange of these resources.

IV.—In order to defend their commerce, their industry, their agriculture, and their navigation against economic aggression resulting from dumping or any other mode of unfair competition the Allies decide to fix by agreement a period of time during which the commerce of the Enemy Powers shall be submitted to special treatment and the goods originating in their countries shall be subjected either to prohibitions or to a special *régime* of an effective character.

The Allies will determine by agreement through diplomatic channels the special conditions to be imposed during the above-mentioned period on the ships of the Enemy Powers.

V.—The Allies will devise the measures to be taken jointly or severally for preventing enemy subjects from exercising, in their territories, certain industries or professions which concern national defence or economic independence.

PERMANENT MEASURES OF MUTUAL ASSISTANCE AND COLLABORATION AMONG THE ALLIES.

C.

I.—The Allies decide to take the necessary steps without delay to render themselves independent of the enemy countries in so far as regards the raw materials and manufactured articles essential to the normal development of their economic activities.

These measures should be directed to assuring the independence of the Allies, not only so far as concerns their sources of supply, but also as regards their financial, commercial, and maritime organization.

The Allies will adopt such measures as may seem to them most suitable for the carrying out of this resolution, according to the nature of the commodities and having regard to the principles which govern their economic policy.

They may, for example, have recourse either to enterprises subsidized, directed or controlled by the Governments themselves, or to the grant of financial assistance for the encouragement of scientific and technical research and the development of national industries and resources; to customs duties or prohibitions of a temporary or permanent character; or to a combination of these different methods.

Whatever may be the methods adopted, the object aimed at by the Allies is to increase production within their territories as a whole to a sufficient extent to enable them to maintain and develop their economic position and independence in relation to enemy countries.

II.—In order to permit the interchange of their products, the Allies undertake to adopt measures for facilitating their mutual trade relations, both by the establishment of direct and rapid land and sea transport services at low rates, and by the extension and improvement of postal, telegraphic, and other communications.

III.—The Allies undertake to convene a meeting of technical delegates to draw up measures for the assimilation, so far as may be possible, of their laws governing patents, indications of origin, and trade marks.

In regard to patents, trade marks, and literary and artistic copyright which have come into existence during the war in enemy countries, the Allies will adopt, so far as possible, an identical procedure, to be applied as soon as hostilities cease.

This procedure will be elaborated by the technical delegates of the Allies.

D.

Whereas for the purposes of their common defence against the enemy the Allied Powers have agreed to adopt a common economic policy, on the lines laid down in the Resolutions which have been passed, and whereas it is recognised that the effectiveness of this policy depends absolutely upon these Resolutions being put into operation forthwith, the Representatives of the Allied Governments undertake to recommend their respective Governments to take without delay all the measures, whether temporary or permanent, requisite for giving full and complete effect to this policy forthwith, and to communicate to each other the decisions arrived at to attain that object.

THE notion that commerce is an interchange to the mutual benefit of both parties was overthrown in Germany not by the crude desire to monopolise the whole profit in a business transaction, but by the patriotic motive of breaking down industries of rival States, and *so* increasing German power and prestige.

—*The Round Table*, June, 1916.

OUR RELATION WITH SPANISH AND PORTUGUESE SPEAKING COUNTRIES.

This issue of THE BEAMA JOURNAL is being circulated especially in Spain, Portugal and the countries of Latin America, and a Spanish section has, therefore, been added containing information on British Electrical, Steam and Allied Industries in both Spanish and Portuguese; a translation in Spanish from an abstract of the technical article by Mr. Frank Walker also appears; Mr. Attías,* a well-known correspondent of papers in Latin American countries, gives an account of interviews with the Consuls in London of Argentine, Bolivia, Brazil, Chile, etc., that will be widely read abroad, in which is shown the solid hold British manufactures have in these countries, and the possibilities for the future.

The Consul General of Bolivia, Don Pedro Suarez, A.M.I.E.E., a prominent engineer who has held many important positions in the Bolivian government, writes that in Bolivia "we have always given preference to products manufactured in the United Kingdom, as we consider them of the best quality."

The tie between the South American Republics and European countries, especially Spain, Portugal, France and Great Britain, has been long established and has been strengthened by business and family associations for generations. Sentiment is not excluded entirely from business transactions by the Latin peoples; the fact that they have had business relations with a firm constitutes a reason for friendship, if the affair has been satisfactory. They are ready to recognise benefits received, and, as European nations have invested the bulk of the capital that has developed the resources of these countries—opened mines, built railways, etc.—the people in South America feel a stronger attachment to Europe than they do to North America. Geographically North American ports are as far away from South American countries—we are not here speaking of Central America—as European ports, and in some cases the distance is greater.

Another factor which indicates that British trade with South America will tend to expand in spite of competition from the United States, is the antagonism which the South American republics feel politically toward the United States, as they do not wish the latter to gain influence and power in their countries; they fear that the great United States may have designs to become a still greater Union.

All the circumstances suggest that the ideals of the Allies are to exert their influence in the moulding of the destinies of South America, which will develop a type of a great civilization, different from that of the United States of North America, perhaps at a distant period, after North America has more definitely defined its type of civilization.

The Abstract from British Standardization Rules for Electrical Machinery and Transformers (excluding Traction Motors) has been translated into Spanish and Portuguese, and will be found at the end of this Journal, following the Directory of Manufactures.

Another article in the Spanish section of especial interest is a spirited indictment of Prussian ideals of human life, by Don Miguel de Unamuno *On German Unity*. The writer is the Rector of the University, the ancient seat of learning, at Salamanca, whose writings are well known in Spain and throughout Latin America. English readers will be delighted to learn the view-point of this cultured representative of a neutral country, on the present conflict of ideals in Europe. Don Unamuno is a profound thinker and writes in that fluid style possible only in the Romance languages and difficult to render into English without losing the inuendoes and subtle philosophical suggestions that are the pith of this article. We have, therefore, only paraphrased the ideas and have not attempted a "translation."

*Author of *The Way to Advertise, The Perfect Salesman*, and *Sanguinary Europe*, in Spanish.

CONCERNING GERMAN UNITY. FROM THE SPANISH OF DON MIGUEL DE UNAMUNO.

A "Germanized" friend was speaking to me recently of the admirable discipline which the German people have undergone for forty years so as to quell internal dissensions for the greater aggrandizement of the Fatherland. While the French, English and Russians, he said, have been wasting their time over foolish civil quarrels, and denouncing the evils in their respective countries, the Germans have been striving with

unity of purpose for supremacy in the world, and they have sacrificed political differences to this end. Far from agreeing with my friend, I see in his explanation the clearest proof of the superiority of the British, French and Russian civilization over German "Kultur." The spiritual superiority of the French people—their respect for human personality—is demonstrated by the fact that the Dreyfus case for some time disturbed the unity of France, for a nation that discusses the sentences of a Military Tribunal and rejects the vicious application of that most dangerous doctrine, "Salus populi suprema lex est," is certainly superior to a nation of spies.

He must be a very bad patriot, indeed, who does not realize that patriotism has *human* limitations, that it is limited on one side by respect for individuality, and on the other by respect for humanity. What respect had that miserable German who, after holding a professorship in an English Institution, went to the United States to condemn the country that had honoured him and given him hospitality? Such incidents remind one of the remark attributed to King Edward VII, that his nephew the Kaiser was not a gentleman, and confirm the theory that the tyrant and the slave are both made of the same material. Was it worth while for the Germans to invent "*Weltbürger*" for this?

It would be terrible if Germany, united and unified to dominate the world, should ever attain her object to regulate social life and organize Europe, which, according to Professor Ostwald, has yet to be organized—and, naturally, by the Germans! To organize the world in the German way would mean, of course, to convert it into a machine.

"The general work of civilization consists in obtaining for the energies that are to be transformed, the most advantageous coefficients of transformation." In this high manner Professor Ostwald defines "progress" in the last chapter of his latest book on energy. His criterion is of the coarsest materialism (he would say "monism") of the close of the XIX. century.

I cannot admire the vaunted German discipline with its ubiquitous *verboten*. It does not answer to any inner feeling; I might admire it if it satisfied an inner need of my real nature. But when I reflect on that desire for strength in order to attack other countries, I see nothing admirable; on the contrary, it appears to me simply non-human and unmoral. No, unanimity is not always a good thing! The unity of a nation of birds of prey does not prove the superiority of that nation. Robinson Crusoe in his loneliness seems to me greater than the entire unanimity of such a nation, whose discipline is that of a gang of highway men.

G. K. Chesterton is right when he says in his *Letters to an Old Garibaldean* that it is in their internal revolutions that nations show their moral greatness. The nation that does not struggle with itself does not progress; it becomes a machine in the hands of a blind oligarchy of tyrants. Even our quarrels and divisions amongst ourselves must be defended before this self-styled superior race.

The ant hill, however perfect, can never be a human ideal. When the German professor Natorp maintained that the individual is not, as the atom, an entity, but that it is an abstraction, he declared in effect that the *E G O* (with capitals) of Fichte, and the *Unique* of Max Hirver were, after all, nothing but abstractions!

The individual human being is the unit of mankind; from it have grown the "humanities" and all the fine things in life. When the supreme value of the individual human soul is not recognized, it is impossible to know Humanity, for it includes and surpasses all countries and all nations. It is the sum total of every race and of every differentiation of mankind. Therefore, we cannot feel Humanity without comprehending all the limitations of every specialized race and nation. Humanity is the genus of all the different species! And the Prussians desired to get above their genus, to surpass Humanity, to become *Übermenschen*! Did they then wish to leave Humanity, to quit this world? No, they desired to dominate it. Unique in this desire, they have defined their type and revealed their limitations as a species only of Humanity. Inasmuch as they desired to raise themselves above the *generic*, they have remained in the *specific*—which is what one would expect from a nation of specialists! No, I cannot see the moral greatness of a nation that restricts political liberties and quells internal dissensions merely in order to prepare itself to dominate other countries.

As to that nonsense about inferior and superior peoples, one can only repeat Robert

Browning's conclusion in Bishop Blougram's Apology—

"Ah, the earth's best can be but the earth's best."

I had always been suspicious that all that inner play of contradictions of Hegel—one of the intellectual fathers of German Imperialism—was nothing but dialectical artifice, as I also felt that the pessimism of Schopenhauer was pure pedantry! This selfish Prussian bourgeoise tried to weigh "pain" and compare it with "pleasure," as one weighs potatoes or bombs. But the real sorrow of the soul, the terrible tediousness which has tormented the great souls of Humanity cannot be "weighed." Did this Prussian "philosopher" know no other suffering than "pain"?

Even from the æsthetic point of view, the Prussians violated the laws of life by discounting the Present and concentrating on the Future. They could not enjoy each day as it passes; they were ignorant of the Art of Life. The present moment did not hold for them all there is in life; the Eternal Now had no place in their philosophy, who were living for *Der Tag*, that triumphant to-morrow which was to contain the superabundance of all their hopes; for that they stifled their individualities. But the French in their controversies over the Dreyfus affair, the British over Irish Home Rule and Fiscal Reforms, and the Russians in their debates in the Duma—all lived and thought in the present, having respect for their individualities and wishing to develop them.

The moral aim of a nation is *to make men*—that of Spain to make Spaniards, of England to make Englishmen, etc., etc. The purpose of the universe is to produce great individuals, and every man is included in this aim.

CO-OPERATION AMONG PRODUCERS.

For the moment there is a lull in the output of plans for National Efficiency. Educational reforms are, it is true, being discussed; but the big schemes for the union of all and sundry have not yet been taken far beyond the stage of paper preparedness. This augurs well, for when the excitement of talk dies down the task may be quietly undertaken by those who sincerely desire to co-operate to strengthen our national resources.

The needs of any situation are always met quietly by those who understand. It was the silent, determined committees of business men in the large industrial centres who first recognised the requirements of the War Office for munitions, and who laid the plans and organized themselves to supply the guns, shells, etc. They were ready in several places to serve the Government when the Ministry of Munitions was appointed, for manufacturers saw before anyone else what was the only thing to do, and declared, "We must do it ourselves!" And from being the most unorganized nation, unprepared for war, we have become highly organized and on the way to win the war! The present splendid service that is being rendered the nation, in ordnance and engineering, *originated* in the voluntary co-operation of manufacturers, large and small, in various centres. As a nation we have proved that we have ability to organize on the basis of individual value and to recognise the merits of one another.

This achievement must surely demonstrate to manufacturers the necessity for co-operation in developing national strength, and the value of exchange of experience between manufacturers for mutual benefit. It will doubtless lead to a new kind of reciprocal interest between firms that will balance competitive individualism. This is possible without forming financial combines that tend to monopolies of industries.

More than once in these columns we have indicated that there is a mean between extreme individualism and the systems known as Trusts (Syndicates) and Kartells, *viz.*, the voluntary co-operation of individuals or firms for mutual benefit and national service. Dick, Kerr & Co., Ltd., for example, have recently secured a controlling interest in Willans & Robinson, Ltd., which, however, has not lost its identity by the transaction; on the contrary its individuality will be preserved and strengthened by the new interest, and both concerns will be the better able to co-operate in the re-adjustment that appears inevitable when peace will have been achieved. There is much discussion on the preparation that is necessary for after-the-war conditions; but preparedness consists of mutual confidence, matured by many conferences of those who really wish to co-operate for the strengthening of British Industry and the preservation of British ideals.

GERMANY'S PREPARATIONS FOR PEACE. By FREDERIC WILLIAM WILE (Author of "The Assault").

"*Germany at the present time offers the paradoxical spectacle of a bellicose nation looking for peace.*"—The Times (June 9).

In the course of a persistent effort by both the spoken and written word to arouse interest in the "War After the War"—the new fight for world trade—I am constantly confronted with the view that Englishmen's foremost task is to "win *this* war." I do not dissent. I quite realize that, *this* war lost, all hope of winning the war *after* would be the quintessence of futility. But as the Allies are bold enough to believe that they are not going to lose *this* war, it is surely the province of Allied business men, and especially the business men of Britain, to look future contingencies in the face at long range, even in the midst of the din and stress which still oppress our thoughts and so amply monopolize our physical and spiritual energies.

It affords me, therefore, the greatest possible satisfaction to be asked by the Editor of The Beama Journal to furnish a concise compilation of Germany's deliberate "preparations for peace." Within the limits of the space he has assigned me, I can only hope to sketch them in barest outline, though my task is made easier by his insistence that the evidence be confined to concrete examples emanating from reliable sources.

WHAT GERMANY HAS TO RECOVER.

Germany's foreign trade, at the outbreak of war in 1914, represented a volume of, roundly, £1,040,000,000. A little less than half of the grand aggregate was export trade—say, £500,000,000. Of the latter total, £380,000,000 represented trade in Europe; £120,000,000 trade outside of Europe, or so-called "oversea" export, £38,000,000 being with the United States alone. According to statistics published in the *Frankfurter Zeitung*, of May 14th, the British Empire in the fiscal year 1913/14 bought £167,500,000 worth of German goods, accounting for about exactly one-third of Germany's total export trade. It is this vast fabric, the creation of years of scientific and intensive effort and exploitation, which collapsed like a house of cards when British mastery of the sea wiped Germany out of the world's markets as completely as if the Hamburg-American Line and the North German Lloyd had never existed. It is to restore the demolished structure at as early a date as possible that the captains of German commerce and industry are now working—working, as they always work, ploddingly, systematically, far-sightedly. They are preparing for "The Day" just as Tirpitz prepared for the Navy's "Day." It seems to me imperatively necessary for the Jellicoes and Beattys of British business to frustrate "The Day" of Ballin, Rathenau, Gwinner and Helfferich, just as the builders and commanders of the Grand Fleet, by advance arrangements, have smashed the hopes of Capelle, Scheer and Hipper. *German Business will essay its Horn's Reef, if present indications count for anything, the moment the military and naval war is ended. It will be beaten back to port in Hamburg and Bremen, effectually lamed, only if sagacious knowledge of its plans and resources enables British Business to meet the onslaught betimes and repel it.*

ENGINEERS TO THE FRONT.

The Germans' preparations for peace are based on the cardinal realization that they have forfeited throughout the world a tremendous volume of that priceless commercial asset, good will, which nothing short of the most prodigious, *centralized* effort can recover. To that end they are now bending every energy compatible with the necessity still to devote vast attention to the prosecution of their war. The war long since became a combat of engineering brains and factory productivity. Hindenburg, Falkenhayn and Mackensen are associated in the popular mind with the preliminary triumphs of the German armies in the field; but the engineers who have made possible the continual and even *crescendo* supply of German guns and shells in the face of the almost complete stoppage of such supposedly indispensable imports as copper, nitrate, saltpetre and cotton are, when all is said and done, the real source of Germany's hitherto invincible military prowess. Having proved the mainstay of Germany at war, it is obvious that the engineers are looked to as the sheet-anchor of the country in peace. I therefore consider no development of Germany's peace preparations more significant than the announcement made in Berlin on June 2nd that

the six leading engineering societies of the Empire have amalgamated "for the purpose of confronting the great new tasks which now so urgently require to be co-operatively solved." The *Deutscher Verband technisch-wirtschaftlicher Vereine* (German League of Engineering-Economic Associations) has been formed out of the following :—

Verein Deutscher Ingenieure (Society of German Engineers). Founded 1856; forty-eight branch societies; 24,500 members.

Verband Deutsche Architekten und Ingenieurvereine (League of German Architects and Engineers). Founded 1871; forty-nine branch societies.

Verein Deutscher Eisenhüttleleute (Society of German Iron-Furnace Men). Founded 1880; 6,000 members.

Verein Deutscher Chemiker (Society of German Chemists. Founded 1887; thirty-six branch societies; 5,500 members.

Verein Deutscher Elektrotechniker (Society of German Electrical Engineers). Founded 1893; twenty-two branch societies; 6,000 members.

Schiffsbautechnische Gesellschaft (Society of Marine Engineers). Founded 1899; 2,000 members.

OBJECTS OF ENGINEERS' "TRUST."

Reporting the formation of this league of all the Empire's scientific talents, German newspapers of June 3rd asserted that it represented roundly 60,000 engineers. Its avowed object, as above indicated, is to serve German industry "co-operatively" in the supreme test which awaits it—the re-conquest of whatever portion of its pre-war position may still be attainable. The preamble of the new League sets forth that it will devote itself quite particularly to promoting technical education, especially in the direction of *standardizing* it. It also aims to make itself the principal adjunct of State and Municipal authorities in framing laws appertaining to engineering and the engineering trades. The League will, furthermore, "be constrained to solidify the bonds between its constituent societies and kindred organizations in the countries now allied to us." The Presidency has been conferred upon Privy Councillor Professor Busley, of Berlin, Germany's most eminent marine engineer, who has played a prominent rôle in the constructional development of the German Navy and mercantile marine. The League has established national headquarters in Berlin and its activities have, apparently, already begun.

THE GOVERNMENT'S PLANS.

About a fortnight before the formation of the Engineers' "trust" an important debate on Germany's commercial future took place in the Reichstag (May 19th). Speaking in the name of the Ministry of the Interior (*Reichsamt des Innern*), which is practically an Imperial Department of Commerce, Under-Secretary Dr. Richter made the remarkable announcement that the Treasury intends placing "not inconsiderable means" at the disposal of German shipping lines for the rehabilitation of the mercantile marine. "A great trade tonnage will be urgently required at the conclusion of peace," declared Dr. Richter, whereupon he indicated that Germany was prepared to embark on an elaborate scheme of State subsidies to that end. He added that, wherever they could be spared, workmen from the Imperial dockyards would be lent to private shipbuilding concerns to facilitate the reconstruction of the German merchant marine with all possible dispatch. Dr. Richter said he did not believe that Germany, "upon the outbreak of peace," would find herself with a large army of unemployed. He was on the contrary convinced that there would in all directions be a lively demand for workmen, and that "we shall experience a period of industrial boom" (*Hochkonjunktur*).

A DUMPING HINT.

Equally significant expressions regarding Germany's future trade plans and aspirations fell from the lips of Reichstag party leaders following Under-Secretary Dr. Richter's statement. Herr Gothein, a well-known Radical Free Trader (a vanishing cult in Germany), said :

"All over the world an urgent demand for ordinary merchandise exists, and after the war our industries will have an extremely busy time. Even among our enemies the conviction is growing more and more that the coming peace must be a lasting one. In order to enable us to export to the full extent of our powers, shipbuilding must be carried on as extensively as possible, because commercial tonnage all over the world has considerably decreased."

IMPERIAL MINISTRY OF COMMERCE.

Another influential deputy, Dr. Stresemann, the General Secretary of the powerful Saxon Manufacturers' Association, made a strong plea for the establishment of an Imperial Ministry of Commerce, separate and distinct from the *Reichsamt des Innern*, which now has charge of all such matters as tariff administration, commercial treaties, regulation of customs and general trade relations with foreign States. The German armies' cannon-ball successes in the field had happily insured the economic independence of the country, Stresemann explained, but a Ministry of Commerce was required to deal with "the economic upheaval which would follow the transition from a state of war to a state of peace." Such a Ministry must proceed far in advance to organize ways and means for combating the "hostile fiscal measures which our present enemies may invoke against us."

"I am free from pessimism," he continued, "but who would have ever believed that England would be able to adopt compulsory military service ? England is proceeding with the greatest recklessness for consequences. She knows no half-measures, no scruples, no sentimentalities, either political or economic."

Since the Reichstag debate of May 19th, the House committee on Industry, Commerce and Trade has favourably considered Dr. Stresemann's project for an Imperial Ministry of Commerce, with the result that the Government has been requested to give Parliament a formal opportunity to discuss the proposal in concrete form.

AN AFTER-THE-WAR M.P.

Not the least significant sign of the commercial times in Germany is the election to the Reichstag (which has just taken place) of Privy Councillor Prof. Dr. Jacob Riesser, founder and president of the great national "business men's party" called the Hansa League. Dr. Riesser, a banker and economist by profession, has been sent to Parliament by the National Liberals in the Heidelberg (Baden) constituency. The German commercial press acclaims the arrival in the Reichstag, "in view of the enormous new tasks which we shall have to face *after the war*," of a practical businessman of Dr. Riesser's eminence. The Hansa League was formed about six years ago to combat the pernicious paramountcy of the Agrarian classes in German politics. It consists of all the powerful manufacturing, shipping, merchandising and financial interests of Germany, and Dr. Riesser will be their official spokesman in the Reichstag. It is the first time he has formally entered political life, and his readiness to do so at this juncture may be regarded as highly significant.

INDUSTRIAL "CENTRALIZATION."

"Organization," that vaunted and sometimes over-rated German panacea for all things economic, is obviously the watchword in this hour of those two great factors, the engineers and the State. It is also, of course, the slogan of the capitalistic and industrial world itself. Always inspired by the dominating consciousness of the up-hill work ahead of Germany in the export field henceforth, great "key" industries like shipping and the chemical trades are leading the way in the direction of amalgamation with a view to centralization and consequent more forceful striking power. A wholesale development of the American "trust" idea seems imminent. Early in April it was announced that the Woermann line—after the Hamburg-American and North German Lloyd, the most important shipping concern of the country—had been practically taken over by the Hamburg and Bremen companies. The fact that many of the Woermann shares are passing into the hands of Herr Hugo Stinnes, one of the masters of the German steel, iron and coal industries, only indicates that there will in future be even a closer alliance between Germany's principal trades. Commenting on the Woermann "deal," the *Frankfurter Zeitung* (so often quoted in this article because it is the chief and official spokesman of German finance, commerce and trade) remarked that it is Herr Stinnes' ambition to link up industrial and shipping interests, especially as "the war makes even more clear the importance of the possession of tonnage, and every day increases its value for the period of the war." Early in May another "centralized" effort in the navigation realm was manifested by the formation of a "War Committee" of German shipowners. The committee has undertaken the task not only of supervising various measures taken by the Government during the war, but will specialize in devising ways and means for the resumption

of German sea trade after the war. The committee will actively pursue all schemes connected with after-the-war economic development, and will doubtless devote much time to working out the scheme of State subventions projected in the Reichstag by the *Reichsamt des Innern*. The Shipping Committee consists of twelve members, with Dr. Greve, of the North German Lloyd, as president. Herr Ballin figures as an ordinary member, but it is safe to conclude that he is the body's ruling spirit. Speaking at the extraordinary general meeting of Woermann Line shareholders on May 29th, Herr Ballin (after referring to " this most gigantic, bloodiest and also stupidest of wars which history knows ") said :—

SHIPPING PLANS.

" It will be necessary in future that the freedom of the seas and our colonial possessions shall be so constituted that we shall not need to exist as if we were England's lodgers. . . . We are quite conscious that after the happy ending of this war we shall have to wage a war in the world-economic field against a competition which has become extraordinarily strong through fantastic war profits, in order to re-establish our old connections. But we shall devote ourselves to this great national task deliberately and undauntedly. We are heartily grateful to the Reichstag, which has already indicated its realization of the importance to our Fatherland of the rapid rehabilitation of our merchant marine. The Reichstag has thereby revealed the determination of the German nation not to abandon Germany's rôle at sea—our determination not to be, as our great political economist, Friedrich List, has put it, ' the step-children of our dear Lord and Master.' "

CHEMICAL COMBINE.

Almost coincident with the formation of the Shipping "War Committee," the great German aniline dye companies, the controllers of still another German " key " industry, announced the syndication for " after-the-war " purposes of practically the whole chemical trade. Hitherto there have been two main groups—the Baden Aniline & Soda Co., Ltd., the Bayer Company, and the Berlin Manufacturing Company, on the one hand, and the well-known Höchst Colour Works and the concerns of Cassella & Co., and Kalle & Co., on the other hand. These six powerful firms have now been joined by the Weilerter-Meer Company, and the seven concerns, with a capital between them of over £11,000,000, have formed a " community of interests." They will retain their individual independence, but in future pool their " experience," and to an extent share profits, while at least all their products will be manufactured by at least two of the companies simultaneously. The new combination has been brought into existence confessedly to meet foreign, and especially British and American, competition. Other important German chemical concerns, like the Wülfling-Dahl and Griesheim Chemical Works, have already applied for admission to the aniline fusion, and it is more than likely that the consolidation will eventually embrace everything of importance in the chemical trade.

There are numerous straws which indicate how the " centralization " wind is blowing in the allied engineering trades of steel, iron, coal and shipbuilding. The names of the master-minds of Stinnes and Thyssen are constantly cropping up in German industrial news of the day. Thyssen, the Carnegie of Germany, has just established " close relations " with the important Vulcan Shipbuilding Company, of Bremen, which means its expansion into a first-class concern. Another amalgamation project in the steel and iron industry is the absorption of the Hüsten and Düsseldorf Tubing Companies, two large independent concerns, by the powerful Gelsenkirchen Mining Company, which is the property of still another great industrial captain, Privy Councillor Kirdorf, the Westphalian magnate. In the midst of war it is amply apparent that the commanders-in-chief of German commerce are finding time, despite pressing current pre-occupations, to plan comprehensively for the future.

ELECTRICAL EXPANSION.

In the electrical trades expansion seems also to be the order of the day, even though " centralization " had reached a high state of development before the war, and resulted in the acquisition of almost monopolistic power by the Allgemeine Electricitäts Gesellschaft and the Siemens-Schuckert group. Early in June, the " Electrical Company, Ltd., formerly W. Lahmeyer & Co." of Frankfort-on-the-Main, announced that it had called up the 75 per cent. balance of £250,000 new shares issued in

December, 1913. The Company stated that the money is required for the completion of "new plant and extensions," which have remained in abeyance, and the cost of which will "run into millions." Evidently the German industry, in whose activities the members of the British Electrical and Allied Manufacturers' Association have the liveliest interest, are anticipating a *Hochkonjunktur* after the war, like Under-Secretary Dr. Richter of the *Reichsamt des Innern*.

There are signs that practically no German industry still "un-cartellized" proposes to remain so much longer. My latest German papers, for example, report that the country's newest "trust" is a "League of Dress-Goods Manufacturers," formed to "meet the needs of the future." The German mania for Cartels is sure to rage more violently than ever.

"CENTRAL EUROPE" ALLIANCE.

Apart from these various individual moves by the State and specific "key" industries, there is, of course, the grandiose "Central European" movement launched six months ago for the purpose of popularizing a hard-and-fast economic alliance between the present Germanic allies—Germany, Austria-Hungary, Turkey and Bulgaria. Projected by a Free-Trade theorist and popular politician named Friedrich Naumann, who is a preacher by profession, it has meantime been the subject of sporadic conferences between German and Austro-Hungarian politicians, officials and economists. Its underlying purpose is to build a preferential fiscal wall round the Continental territory "stretching from the North Sea to Baghdad," thus offsetting to a certain degree the eternal trade losses which the Germanic nations quite clearly realize they have suffered in the rich countries with which they are now at war. "Central Europe" has been a pretty catch-phrase, but hard-headed commercial authorities, like Herr Ballin and Herr von Gwinner, of the Deutsche Bank, have steadfastly refused to lend their countenance to Naumann's chimera. Ballin and Gwinner understand perfectly well that Germany's trade future lies primarily where Germany's trade past has been; that effort must be concentrated there, as it was before, and that activity in the direction of South-Eastern Europe, while commendable in itself, will amount to chasing a phantom, if there is any attempt to make believe that Balkan and Ottoman markets can ever compensate Germany for the trade plums she has so long picked in England, Russia, France, Italy and Belgium.

WHAT GERMANY HOPES FOR.

A recent series of highly informative articles in the *Frankfurter Zeitung* (pungently summarized in *The Times* of June 8th and 9th by my former Berlin colleague, Mr. J. E. Mackenzie, and a careful reading of which I heartily recommend to all thoughtful British business men), throws unmistakable light on Germany's commercial schemes for "after-the-war." Manifestly she hopes, most fervently of all, for a gradual semi-resumption of her old-time business relations abroad on the ground that "natural conditions" will go far toward restoring them. She seems to pin much faith in her ability to "enforce" trade concessions, such as most-favoured-nation tariff privileges, at the forthcoming Peace Conference—whenever that is to be—in return for abandonment of her pretensions to Allied territory now occupied by German troops. The Germans, Mr. Mackenzie thinks, hope to out-Bismarck Bismarck by repeating on a wholesale scale his feat of binding France (in the Treaty of Frankfort) to give Germany perpetual most-favoured-nation rights in her market. We are introduced to a typical and illuminating German vision of the future in the concluding paragraph of the *Frankfurter Zeitung's* symposium, which I reproduced in "Germany Day by Day" in *The Daily Mail* of May 18th:—

"The world needs Germany. World commerce would itself be terribly impoverished by our exclusion. Our work is required, for what this work has accomplished in the enrichment of life has benefited not only us, but all. The knowledge, experience and energy of a nation of the greatness of Germany cannot be eliminated from the general scheme of the peoples without making other peoples themselves poorer and thirstier. Before the war foreign nations did not purchase our wares out of love. They bought them because they wanted them, because many of them could not be produced in other countries at all, because they were good and cheap, because the German manufacturer adapted himself cleverly to the needs and wishes of customers, and because the German merchant

granted credit cheaply and cheerfully. All that will remain."

"THE DAY."

The Germans, in other words, believe that the foreign trading universe will prove to have too short a memory for the horrors which have besmirched the German name during the war to be governed by any other factor than the sordid law of price, supply and demand. They believe that the German, order-book in hand, will be as welcome in Britain as he was before, if he comes again with the proper samples, the attractive quotations and the old-time oiliness of manner and suasion. It will be an interesting contribution to the commercial literature of our generation some day to record the fate of these optimistic Teutonic hopes. Forewarned is forearmed. If the businessmen of Britain find themselves unprepared on "The Day" which Ballin and Company are preparing for, I fear they will have only their own complacent and short-sighted selves to thank.

THE BEAMA JOURNAL's publication of this article is gratifying proof, at any rate, that the British electrical trade does not intend to be found "asleep at the switch."

FINANCE FOR BRITISH FIRMS.

The President of the Board of Trade has appointed a Committee to consider the best means of meeting the needs of British firms after the war as regards financial facilities for trade, particularly with reference to the financing of large overseas contracts and to prepare a detailed scheme for that purpose.

The Committee will consist of:—

The Lord Faringdon (Chairman).
Mr. B. P. Blackett, C.B.
Sir W. H. Clark, K.C.S.I., C.M.G.
Mr. F. Dudley Docker, C.B.
Mr. Gaspard Farrer.
Mr. W. H. N. Goschen.
Rt. Hon. F. Huth Jackson.
Mr. Walter Leaf.
Hon. Algernon Mills.
Mr. J. H. Simpson; and
Mr. R. Vassar-Smith.

Mr. Hartley Withers will act as secretary to the Committee.

A PROTECTIVE TARIFF FOR THE ELECTRICAL INDUSTRY. By DAVID TOLLEMACHE, F.R.S.L.

The fiscal question is one with which almost every British industry is vitally concerned, and none more so than that which is connected with the production of electrical machinery and appliances. Few, if any, industries have suffered so much from unrestricted foreign competition, or stand to benefit more by a reform of our fiscal system.

It is now admitted by the great majority of the business men of this country that a reversal of our present fiscal policy is now not only desirable, but necessary. Before dealing specifically with the electrical industry I may be allowed to prove this point, and to show how the change of opinion has come about.

A CHANGED SITUATION.

The events of the war, and the conditions which, it is realized, must inevitably prevail after the conclusion of peace, have done more to convince the nation of the inadequacy of our present fiscal system than all the eloquence of Mr. Chamberlain or the earnest pleadings of Colonial Premiers at Imperial Conferences. Even those who are strongly opposed in theory to anything in the nature of protection admit the impossibility of returning to pre-war conditions of trading with Germany, and recognise the fact that, in the words of that orthodox Cobdenite, Mr. Harold Cox, in the *Sunday Times*, of April 23rd: "In order to establish any system of tariffs which would penalize German trade while facilitating British, French, Italian, Belgian and Russian trade, it is essential to take a step which will certainly shock the stricter sect of English Free Traders."

OPINIONS OF BUSINESS MEN.

This change in the attitude of the public, and particularly of business men, towards the fiscal question, is reflected in the resolutions recently passed by Chambers of Commerce all over the country, and confirmed by their delegates at the Conference of the Associated Chambers held in London on February 29th. The following resolution, passed at the Conference, correctly summarises the views of the business world on the present situation: "That this Association is of opinion that, with the object

of maintaining and increasing our trade after the conclusion of the war, it is necessary that the different parts of the Empire be drawn into closer commercial union, that the relations with our Allies should be fostered, and that for the accomplishment of these purposes it is desirable that provision should be made (*a*) for preferential reciprocal trading relations between all parts of the British Empire; (*b*) for reciprocal trading relations between the British Empire and the Allied countries; (*c*) for the favourable treatment of neutral countries; and (*d*) for restricting, by tariffs and otherwise, trade relations with all enemy countries, so as to render impossible a return to pre-war conditions, and for stimulating the development of home manufacture and the consequent increased employment of native labour."

Further evidence of the changed feeling among business men is afforded by the result of the voting for twenty-two elective members of the Manchester Chamber of Commerce last March, when the Tariff Reformers secured the return of nineteen of the twenty candidates they put forward. Such a result in the very citadel of Free Trade is a significant sign of the times.

WHAT THE GOVERNMENT SAY.

The Coalition Government, although hampered by the presence of one or two rigid Cobdenites in their midst, have shown that they regard favourably the views of the business world. They accepted and gave their official blessing to a resolution moved by Mr. Hewins in the House of Commons on January 10th, urging them to "enter into immediate consultation with the Governments of the Dominions in order with their aid to bring the whole economic strength of the Empire into co-operation with our Allies in a policy directed against the enemy." Mr. Runciman, in accepting the motion on behalf of the Government, said: "We must make it clear, when peace has to be signed, that we cannot permit the outbreak of another economic war by Germany against us. . . . Having ended this war victoriously, we must not give Germany a chance of reconstructing her economic machinery. It will be necessary in making peace to see to it that Germany does not again raise her head." The Chancellor of the Exchequer, too, in addressing the Conference of the Associated Chambers of Commerce, announced that "the Government are prepared to give their assistance to the development of foreign trade in order to ensure that those rivals who are now our bitter enemies shall not have the control of foreign trade which they have enjoyed in the past." Did space permit, other Free Trade members of the Government, such as Mr. Samuel and Mr. Montagu, might be quoted to the same effect.

That this movement is not confined to business men, but has taken root among all classes of the community is evidenced by the wave of enthusiasm which has greeted the speeches of Mr. Hughes, the Australian Prime Minister, and by the formation of a great working class organization—the British Workers' National League—whose objects, *inter alia*, are "to put an end to the *laisser faire* policy which would mean the ruin of England, and to bring about a reversal of the Little England Cobdenite doctrines of the Radical Party."

Having thus shown that Tariff Reform is no longer a party but a business question, and that the time is ripe for its adoption, let us see how the electrical industry of this country would be affected by the change.

OUR CHIEF COMPETITOR.

It need hardly be said that our principal competitor in electrical machinery and appliances, both in our home market and in the markets of the world, has been Germany. In 1913, the year before war broke out, we imported from Germany electrical machinery to the value of £721,078, and other electrical machinery to the value of £926,000. If we add to these amounts the value of electrical goods imported from Austria-Hungary—£7,913—we arrive at a total of £1,634,991, imported from enemy countries. As our total imports of electrical goods of all kinds amounted in 1913 to £2,933,294, it will be seen that the proportion received from these two countries was about 56 per cent. The war has cut off these sources of supply, and it is for British electrical manufacturers to say whether the home market is in future to be supplied from home sources, or from foreign countries. There can be no question as to the capacity of our manufacturers, in normal times, to turn out any required quantity of electrical goods. The Government Census of Production shows that, in 1907, electrical machinery, instruments and apparatus, to the

value of over £14,000,000, were produced in this country, and the quantity has increased greatly since that year. Given a fair field and no favour, the British manufacturer can hold his own against all comers. But he has a right to demand protection against unfair forms of competition, such as selling below cost price by subsidised foreign manufacturers. The German manufacturer, having his own protected home market of seventy million people in which to make a profit, can well afford to dump his surplus products in this free market at or even under cost price, or to accept contracts at rates with which British manufacturers cannot compete. Such sales enable him to produce upon a larger scale, and therefore at less cost, and strengthen him in his efforts to dominate the British market.

PUBLIC BODIES ENCOURAGE "DUMPING."

It is a thousand pities that such tactics should have been encouraged by public bodies in this country, but in numerous cases electrical contracts have been given to German firms because of the lower prices they have been able to quote. Thus, we read in the *Western Mail* of June 4th, 1913, that "The Newport Corporation have decided to place abroad a contract for the supply of electrical equipment. There will be a gain to the Corporation of something over a thousand pounds in respect of contract price by placing the order in Germany; but more than that sum will thereby be lost in wages to English workmen and remuneration of English capital. We say more than that sum, because it is admitted that the German quotation is not a genuine business figure, and it may be accepted without a doubt that it is below cost price, and considerably lower than what would be charged to a German customer. The German firm can afford to do this, because it has at its back an indemnity fund to which it and similar manufactuerrs contribute, and which the German Government also assists by way of bounties."

Unfortunately, there will always be found a number of people who worship the fetish of so-called cheapness, and who, like Sir Hugh Bell, are quite prepared, when peace is signed, to go back to our old terms of trading with Germany. The only way in which to circumvent the unpatriotic action of such people is to put a sufficiently high tariff on foreign goods, and particularly goods of enemy origin. The German would then no longer find it profitable to dump his goods on our shores, and his dreams of capturing the British market would be rudely dispelled.

A WORKERS' QUESTION.

There is also the workers' side to this question. If the electrical machinery and appliances we have been in the habit of importing from Germany were made in this country, it would mean an addition of about £16,000 a week to the wage bill of this industry, representing 8,000 more workers at 40s. per week. If the electrical goods we purchased from the United States last year (£894,639) were made by British manufacturers, there would be a further addition of about £9,000 a week to their wage bill, representing about 4,500 more workers. I quite recognise that, at the present time, when so many men are required for the Navy and Army, it is impossible to make all the electrical goods we require, and we must therefore import a certain proportion from neutral nations, but surely we do not mean such a state of things to continue permanently. Now is the time in which to be preparing for the keen and bitter trade war which will inevitably break out on the cessation of military hostilities, and to see that the interests of our manufacturers and workers are so safeguarded by means of a tariff as to ensure that all our electrical requirements shall be supplied by British capital and labour. An immediate declaration of policy by the Government on this point is absolutely necessary. Manufacturers cannot be expected to lay down expensive plant and reorganize their works unless they have some definite assurance that never again shall Germany be permitted to send her surplus goods into our market free of tax or toll.

OUR EXPORT TRADE.

I have dealt, up to now, only with the home market, and the effect of a tariff upon its productiveness. We will now consider briefly the position of our foreign and colonial trade in electrical goods.

In 1913 we exported electrical goods to the value of £7,655,703, of which £3,285,419 went to foreign countries, and £4,370,284 to British Possessions. To Germany we sent only £116,231 worth. It will thus be seen that 57 per

cent of our total export trade in electrical machinery and appliances went to our own Dominions and Colonies, and 43 per cent. to foreign countries, while our exports to Germany were almost negligible. Germany's total exports of the same class of goods to all countries in 1912 (the latest available figures) amounted to over £8,000,000. These figures are in themselves a refutation of the Free Trade assertion that a tariff acts in restriction of trade. If a highly protected nation, such as Germany, can maintain such a large export trade in electrical goods, British manufacturers need not fear that an extended tariff in this country will handicap them in any way in the world's markets. It will, indeed, have a precisely contrary effect, as I shall endeavour to show.

NO BARGAINING POWER.

The chief difficulty our manufacturers have in finding markets abroad is due to the tariffs with which all civilized countries, except our own, protect their home industries. Better terms of entry into these countries can only be obtained by tariff bargaining. If we say to a country, "We will admit your staple manufactures into our markets on preferential terms if you will give similar tariff preference to certain specified British industries," it is probable that a bargain favourable to both countries will be struck. But under our present Free Trade system we have nothing wherewith to bargain. When Japan reformed her tariff, in 1910, Count Komura, in introducing the Finance Bill, said: "In some cases we may fix upon conventional tariffs, but such conventions will not, as in the existing treaties, be one-sided, but will be reciprocal. As Great Britain is pursuing what is called a Free Trade policy there is no room for a convention with that country." Tariff Reform, then, will give us a bargaining power which we do not at present possess, and will thus enable us to secure easier access to foreign markets for British goods.

THE "MOST FAVOURED NATION" FALLACY.

But, some one may ask, are we not already on as good a footing as any of our rivals in foreign markets owing to the operation of the "most favoured nation" clause in our commercial treaties? On this, I have two things to say. Firstly, the value of the "most favoured nation" clause has been greatly overrated. Owing to the elaborate sub-divisions and classifications in modern tariffs it often happens that a tariff reduction obtained from one tariff country by another applies only to a particular class of goods produced by the latter. In such cases the "most favoured nation" clause, it is obvious, is powerless to enable other countries to share in the benefit of such reduction. And secondly, I would say that after the war, new treaties will have to be negotiated, in which the "most favoured nation" clause will not find a place. It is quite unthinkable that we and our Allies will give to the enemy countries the same terms of access to our markets as we shall give to one another. Our new tariff policy, I venture to forecast, will establish a four-fold tariff schedule, which will provide for low rates on goods from within the Empire, slightly higher rates on goods from our Allies, still higher duties on imports from neutral countries, and maximum duties on goods from enemy countries. Our Allies will doubtless re-model their own tariffs with a similar object in view, while neutral countries will endeavour to make the best possible terms with us by offering reciprocal advantages. There will thus be no room for the "most favoured nation" clause.

TRADE WITH OUR ALLIES.

We may be quite sure that German electrical goods will, for a long time to come, be excluded from the markets of our Allies, so far as national sentiment and a high tariff can keep them out. There will be a strong inclination, aided by a preferential tariff, to place in this country the orders which aforetime went to Germany. To these markets, in 1912, Germany sent electrical goods to the value of £2,165,500, made up as follows: France, £340,000; Russia, £968,000; Italy, £586,000; and Japan, £271,500. There is no good reason why this trade, or at least the greater part of it, should not be captured by British manufacturers.

NEUTRAL MARKETS.

Then there are the great neutral nations of the Continent, most of them favourable to the Allies, with whom, if we possessed the negotiating instrument of a tariff, we would doubtless be able to arrange for better terms of entry into their markets than we enjoy at present. To Denmark, Holland, Norway, Sweden, Spain, and Roumania, Germany sent, in 1912, electrical goods to the value of

£1,132,000. There should be no great difficulty after the war in diverting much of this trade into British channels.

From the great markets of South America, too, Germany is at present completely cut off. To Argentina, Chili, Brazil, and Uruguay, Germany sent, in 1912, electrical goods valued at £944,000. The demand for these goods continues, but Germany cannot supply them. Now is the time, therefore, to make a bold effort to gain a dominant position in these markets, and to entrench ourselves so securely in them by mutually beneficial tariff arrangements that Germany will never be able to recover the trade she has lost.

OUR BEST CUSTOMERS.

But, after all, it is to our great self-governing Dominions that we must chiefly look for an expansion of our export trade in electrical goods. They already take considerably more than half our total exports of electrical goods, and their future potentialities as customers are unlimited. Previous to the war, the tentacles of the German octopus had taken a firm hold on various branches of industry in Australia, Canada, and South Africa, and German exports of electrical goods to these countries were increasing at a greater rate than our own. But the Dominions are applying themselves systematically, energetically, and successfully to the work of destroying German trade and influence within their borders. It is quite certain that no orders for electrical machinery and appliances will go to Germany from British Possessions for a long period after the war. To whom will these orders go? They ought, without a doubt, to go to the Mother Country. We have the advantage, not only of the sentiment which springs from kinship and from mutual sacrifices of blood and treasure in the war, but we have also the material advantage of a tariff preference in the markets of the Dominions. The one thing wanting to bind the Empire together in a great economic alliance is for us to reciprocate the preference freely given us by the Dominions, by admitting their produce and manufactures into the British market on better terms than the produce and manufactures of foreign nations. This measure of justice has been repeatedly asked for by the Dominions at Imperial Conferences; it can now no longer be refused. Firmly established on the basis of mutual preference, our trade in electrical goods with the Dominions will grow and prosper at an ever-increasing rate, and no envious rival will be able to take it from us.

A CHANGE OF POLICY NECESSARY.

I have thus briefly, but as fully as space will permit, attempted to show that the whole business world is convinced of the necessity for a change in our fiscal policy, and that the electrical industry is especially interested in such a reform being brought about. I have shown, from official figures, how great a hold Germany has had in this industry upon our own home and over-sea markets, and upon the markets of our Allies and of neutral countries. I have proved, I trust, that the only way in which this grip can be permanently released and conditions of fair competition established is by the adoption of a tariff system which will (1) preserve our home market for the home producer; (2) enable us, in conjunction with our Allies, to deal a deadly blow at Germany's commercial ambitions; (3) obtain for us better terms of entry into the foreign markets; and (4) secure for us the rapidly developing markets of the Dominions and other parts of the British Empire. These are objects which every British manufacturer of electrical machinery and appliances must have at heart, and the only method by which they can be attained is the one I have pointed out.

HANDICAPS ON BRITISH TRADE. By FRANK BROADBENT, M.I.E.E.

In the January issue of THE BEAMA JOURNAL some of the handicaps on British export trade were referred to,* among which were the handicaps of colonial *ad valorem* import duties, heavy railway charges, preferential ocean freights given to foreign manufacturers, etc. Considerable data bearing on these and other points were given by B.E.A.M.A. witnesses to the Sub-Committee of the Advisory Committee of the Commercial Intelligence Department of the Board of Trade during the enquiry held in December last, and certain recommendations were made thereon.

* *v.* Unfair Handicaps on British Export Trade, THE BEAMA JOURNAL, January issue, 1916, page 16.

Although the handicaps specified above have reference more particularly to export trade, there are many others which apply equally to the home trade, the two being so intimately connected that it is practically impossible to treat them as entirely separate and independent entities.

We are indebted to many members of the B.E.A.M.A. for having, at a time like this when staffs are shorthanded, given us specific data bearing on the handicaps under which British manufacturing trade is carried on. At the proper time this information will be placed before the authorities, and it is confidently hoped that the Conference of Manufacturers and Railway and Shipping Authorities recommended by the B.E.A.M.A.† may be called together, when these points could be thoroughly discussed with a view to evolving measures which shall have the effect of assisting and encouraging the development of British Manufacturing Industries, rather than as at present hampering and restricting them in every possible way.

PREFERENTIAL EXPORT RATES.

In Germany, where most of the railways are State-owned, special export rates are given with a view to assisting and developing the export side of industry. Goods marked for export are carried at approximately half the ordinary rates charged for inland traffic. In some cases the export rates on German railways are as low as one-third of a penny per ton per mile, a rate which is considerably lower than the rate for bulked goods, such as coals and minerals, on British railways.

The granting of special rates for export, whilst it has not yet become regularized in England, is in partial operation, as will be seen from the following table :—

From	To	Approximate distance in miles.	Special machinery rate.	Export rate.
Bolton....	Hull & Grimsby	100/116	.. 24/7	.. 18/2[1]
Manchester	,,	93/109	.. 21/-	.. 17/6
Rugby....	,,	193/209	.. 26/-	.. 23/5
Manchester	Southampton	245	.. 44/7	.. 25/-
Rugby....	,,	160	.. 30/5	.. 21/8
Glasgow ..	London	400/440	.. 49/5	.. 41/7*
Manchester	,, ...	183/205	.. 33/10	.. 26/-*
Rugby....	,, ...	83	.. 21/8	.. 21/8*
Sheffield ..	,, ...	160	.. 30/11	.. 27/4*
Glasgow ..	Liverpool ..	340	.. 24/3	.. 20/10

[1] Excludes cartage.
* This includes the port of London dock charges.

† *v.* The Board of Trade and British Trade after the War. THE BEAMA JOURNAL, April, 1916, p. 66.

In some cases the special export rates are given by the railways because of shipping competition, *e.g.*, from Manchester and Glasgow to London, and from Manchester to Southampton and Hull, whilst in other cases the special rates are on account of the large export trade carried on from particular manufacturing centres.

There is, however, ample justification now for preferential rates being demanded from all the principal manufacturing centres to the principal ports, more particularly in those cases where the railway lines run right into the docks, as this eliminates cartage and minimises the amount of handling.

CLASSIFICATION.

Many anomalies exist in the classification of machinery and apparatus which are included under the general term of Electrical Engineering, due largely to the fact that new apparatus has been called into existence which was not included in any of the original classes. Now that the size and weight of individual pieces tend to increase, the question of classification is becoming more and more serious.

Heavy machinery, including agricultural engines, steam, gas and oil engines, and hydraulic machinery, may be rated under what is called the "mileage" scale of charges instead of under the arbitrary rates charged from point to point for other machinery. Electrical machinery does not come under the mileage classification, hence, in shipping a turbo-alternator the turbine may be charged at the mileage rate and the alternator at the ordinary machinery rate.

The machinery rate, moreover, is not a level or fixed rate for all classes of machinery, but is subject to percentage additions, depending on the weight of single pieces. As an example of this, take a case in which the ordinary machinery rate is 20/- per ton, the following percentages are added in respect to heavy weights :—

Pieces weighing	10 to 15 tons,	20%	increase	=24/-	ton.
,,	,,	15 to 20 ,,	33⅓%	,,	=26/8	,,

Pieces weighing 10 to 15 tons, 20% increase =24/- ton.
,, ,, 15 to 20 ,, 33⅓% ,, =26/8 ,,
,, ,, 20 to 25 ,, 50% ,, =30/- ,,
,, ,, 25 to 30 ,, 75% ,, =35/- ,,
,, ,, 35 to 40 ,, 100% ,, =40/- ,,

Heavy pieces of the above order would generally be put on trucks at a special siding in the manufacturer's works and delivered without transhipment to the docks alongside the steamer. There would be therefore an abatement from

the above charges of the amount included in the railway rates for cartage, but this abatement becomes of less and less importance as the weight increases.

It is important to observe how the electrical side of the industry is handicapped by the application of these arbitrary railway rates.

Assume that a manufacturer wishes to despatch from his works an alternator of which the rotor weighs, say, 21 tons. If the ordinary machinery rate is 20/- the special rate for this weight as shown above would be 30/- per ton, or allowing a rebate of 3/- for cartage the nett charge would be 27/- per ton. For an equivalent weight the rate on the mileage scale would be approximately half this amount, namely, 13/6.

Hence, whilst a steam or gas engine weighing 21 tons might be carried 80 miles for £14 3s. 6d., an alternator, or part of an alternator, of the same weight would be charged £28 7s.! This is by no means an extreme case, as for longer distances and heavier pieces the handicap on electrical machinery would be far greater.

Again, the question of packing in cases or in frames is one which needs revision. It is safer in many cases to bolt certain classes of machinery to stout frames rather than to pack same in frames or cases; that is to say, there is less risk of damage during transit when protected in this way. In the event of damage, however, it would be a debatable point as to whether or not the machinery was sent unpacked at owner's risk or in frames at companies' risk.

THROUGH RATES.

Another and a very serious handicap which the British manufacturer labours under when in competition with German shippers is the enormous advantage which the German manufacturer is able to obtain by means of the low through rates. Cases have come to our knowledge in which this has operated very harshly against the British manufacturer.

In one case a British manufacturer having to ship about 5C0 tons of material to South Africa, including many heavy pieces of about 30 tons weight, was offered by the representative of a powerful German electrical combination special shipping facilities if he would ship his goods to Hamburg and then let them go through as part of a consignment from the German firm in question. This, as was clearly shown, would have effected a saving of about £750 in freight, notwithstanding the fact that the North German Lloyd's, who would carry the goods from Hamburg to South Africa, were in conference with the Union Castle Line, the British company operating from our home ports. Whilst it is clear that the German manufacturer can obtain special terms, it is quite possible that an examination of the books would show that the North German Lloyd's receive the full amount of the freight, the difference being made up in some way by subsidy from the German Government.

The British manufacturer was prevented from availing himself of the advantageous rates offered by the fact that he would have thereby lost his 10 per cent. rebate on twelve months' shipping.

Another case, also concerning South Africa, is one in which a large quantity of machinery was specified, for which a British tender was the lowest, the amount involved being about £100,000 F.O.B. port of despatch. The representative of a German group induced the purchaser to call for fresh tenders C.I.F. with the result that the German offer was much lower than the British and the work naturally went to Germany. It is pretty obvious what happened, namely, that the German company approached the Government, pointing out that there was a contract of £100,000 at stake and that a special through rate was necessary in order to secure the order for Germany. There is no doubt that this is what happens over and over again.

The foregoing are merely a few of the many points which the B.E.A.M.A. are taking up and placing before the Board of Trade Committee, with a view to some scheme being evolved which shall place the British manufacturer in a better position after the war than he has been hitherto.

IF the Germans have been mastered by the militarist error, most of the Democracies have been mastered by the pacificist error—*The Round Table, June, 1916.*

ELECTRICAL DRIVING OF ROLLING MILLS FOR IRON AND STEEL. By G. M. BROWN, M.A., B.Sc.

Not the least striking of the great engineering developments of the last two decades has been the wide and increasing application of electrical power in the heavy metallurgical industries, and more especially those concerned in the production of iron and steel for structural purposes. Fifteen years ago electricity was regarded as a convenient agent for driving auxiliary machinery, such as saws and shears, and even live roller tables; but the boldest engineer would have hesitated to predict that within that short period the electric motor would become the standard means of driving the largest and heaviest continuous and non-reversing mills, and would also be applied to the most powerful reversible cogging and slabbing mills.

Prior to these great electrical developments, the amount of knowledge available concerning the power required to drive rolling mills was strictly limited to the results of a few careful tests of steam-driven mills; and in view of the labour and expense involved in the execution of the tests and the numerical calculation of the results this is not surprising. With the advent of the electric motor of large power, and its application, the possibility of accurately determining the power required to roll various sections was quickly recognised, and a mass of information on this subject is now available to all concerned with the design and operation of rolling mills for iron and steel, billets, bars and rails. The amount of data on the power required for the rolling of fine sheets and similar products is, however, comparatively meagre, and the design of plant for this purpose rests largely on an empirical basis.

The power required to roll a given section is dependent on a number of circumstances, and is generally widely different from that required simply to change the shape of the material. The use of the electric motor for driving the rolls has made it a comparatively easy matter to determine the power required to drive the rolls light, as well as when material is passing through them; but there is still no easy and certain method of deciding how much of that power is absorbed in overcoming the extra frictional resistances of the roll necks, pinions, etc., and in many cases these resistances absorb a very large portion of the additional power required during the passes. In view of the practical impossibility of separating the two components, it is evident that the determination of the power required to roll any given section cannot be made to depend on any general formula.

The power required to drive a rolling mill depends largely on the temperature at which the material is rolled, and therefore indirectly on the nature of the material. For instance, high carbon steel must be rolled at lower temperatures than are permissible with ordinary mild steel, so that more power is required to roll strips of tool steel and spring steel than is required for similar strips of mild steel; and all parts of the mill and driving mechanism are subject to greater loads. The results of Puppé's experiments indicate that if both high and low carbon steels were rolled at the same temperatures the powers required would be approximately equal.

In addition to the nature and temperature of the material, the nature of the deformation it undergoes in passing through the rolls has a very marked effect on the power required to produce a given displacement of material. Naturally the material, more or less plastic as it may be, is most efficiently displaced by a direct pressure or squeezing action; and any attempt to effect this displacement by indirect pressure, such as may be produced by slightly inclined sides of roll grooves, is attended by increased pressure on the rolls and by increased frictional losses. In the production of girders, flat bottomed rails, etc., it is impossible to avoid a certain amount of this indirect displacement; and the object of the roll designer is to reduce it and therefore the power required to drive the rolls, to a minimum.

Decisions on the rolling temperatures, probable behaviour of the material at these temperatures, and the proper calibration and design of the rolls, are evidently within the duties of the mill owner or manager, and are generally accepted as being in his particular province. He also decides at what particular speed his mill is to run while it is producing a given section, and the output expected, and thus settles all the matters which must be taken into account in determining the power it will require.

Such being the case it might reasonably be expected that in every instance where it is decided that a mill should be electrically driven, the enquiries issued to electrical contractors would specify the normal and maximum output of the motor required and all other particulars necessary for the preparation of an intelligent

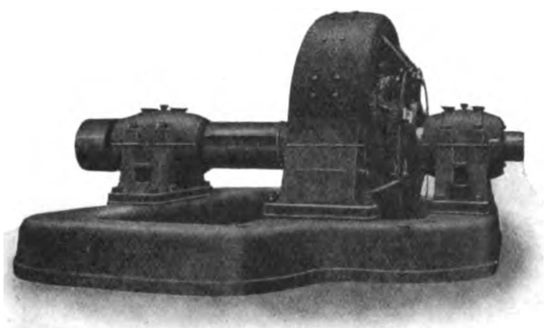


FIG. 1.

350 H.P. 130/170 R.P.M. ROLLING MILL D.C. MOTOR WITH SHAFT PREPARED FOR FLYWHEEL.

offer. In some cases this is done, but it is the exception and not the rule. Generally the enquiry specifies the output required from the mill alone, or both power and output, and the contractor is asked to guarantee the latter, and thus to take responsibility for a number of operations and conditions all directly affecting the output and all beyond his control, as well as being outside the sphere of his legitimate activities. It is true that some of the more important electrical engineering concerns have devoted special attention to rolling mill work and amassed a large amount of valuable information and experience, and are therefore well qualified to advise the mill owner and engineer as to power required for the desired output under normal conditions. The mere fact, however, that they are willing to render assistance of this kind freely and in all good faith, cannot justify any request from the mill owner that they should take such complete responsibility for the design and operation of a mill and its accessories, as is implied by an absolute and unconditional guarantee that a given output will be maintained with the electrical plant they may recommend and supply.

The function of the electrical contractor is to supply electrical machinery capable of exerting the power specified by the mill engineer, and the mill engineer should be ultimately responsible for the sufficiency or otherwise of that power.

The power of a well-designed electric motor is generally limited by the heating effect of the current required to drive it, and its capacity for overloads of short duration, such as are incidental to rolling mill service, is very much greater than that of a steam engine of the same rated power. Unless, therefore, some automatic device be used to limit the current, which the motor can draw from the line, it is possible, for short periods, to force the output of an electrically driven mill far beyond the limit that would be possible were it steam driven. The characteristics of the electric motor are such that the drop in speed of the flywheel is slower, and its subsequent rise to the normal speed is much more rapid, than it would be if the same mill were driven by a steam engine of equal power; and therefore greater loads may be applied without undue reduction of speed. The result is that the operatives, after some little experience, are able to increase their output and remuneration, and at the same time learn that they may apply heavier loads without causing any stoppage or very great reduction of speed, such as would follow were the mill driven by a steam engine.

In many steam engine-driven mills the flywheel effect is comparatively small, and a few heavy passes following in quick succession, or even one heavy pass, will cause a considerable diminution of speed. In the case of a motor-driven mill, extreme fluctuations of speed generally involve undesirably large fluctuations of the power required by the motor; and, if these are to be avoided, a larger flywheel is necessary to ensure a greater uniformity of speed and power input to the motor. The increased flywheel effect makes it possible to deal with heavier loads provided they are of short duration, and this capability is increased by the fact that as the speed of the motor drops, its torque and power increase, so that the flywheel is brought back to its normal speed more quickly than it would be by a steam engine of the same rated power as the motor.

The general result of substituting an electric motor in place of a steam engine is to increase the average speed and the output of a mill, even when the flywheel effect remains unaltered, and this should be taken into account

in determining the appropriate power and overload capacity for the motor.

The best method of connecting the motor to the rolls depends largely on the size and nature of the mill, and, in the case of an existing mill, on its general arrangement and construction. In the space available for this article it is not possible to discuss fully the various combinations in use.

In the case of small bar and rod mills, the roughing and finishing rolls are sometimes arranged in one line, and are therefore driven at the same speed, which is limited by the working of the roughing stand. The motor may be directly connected to the shaft carrying the flywheel, by some suitable form of flexible coupling, while the flywheel shaft is connected to the pinions in the usual way. An alternative is to mount the flywheel directly on the motor shaft, in which case it is advisable to take special care that the coupling to the pinions is such that no appreciable end-thrust is transmitted to the motor shaft. Fig. 1 shows a 350-H.P. motor for a drive of this kind. The shaft is prepared to take a heavy cast steel flywheel, and arrangements are provided whereby the speed can be varied between 130 and 170 r.p.m., according to the nature of the work in hand.

As a rule it is desirable to use larger and heavier rolls for the roughing passes than for the finishing passes, and to run them at a slower speed, and then it is possible to drive the roughing and finishing rolls by two separate motors; or, as is more generally preferable, to use a single motor directly coupled to the finishing train with a rope drive on to a heavy flywheel connected to the roughing rolls. Fig. 2 shows a small rod mill arranged in this manner and driven by a 150-H.P. 360-r.p.m. induction motor. The motor is connected by a flexible coupling to a shaft which drives the finishing train and carries a rope pulley for driving the roughing rolls.

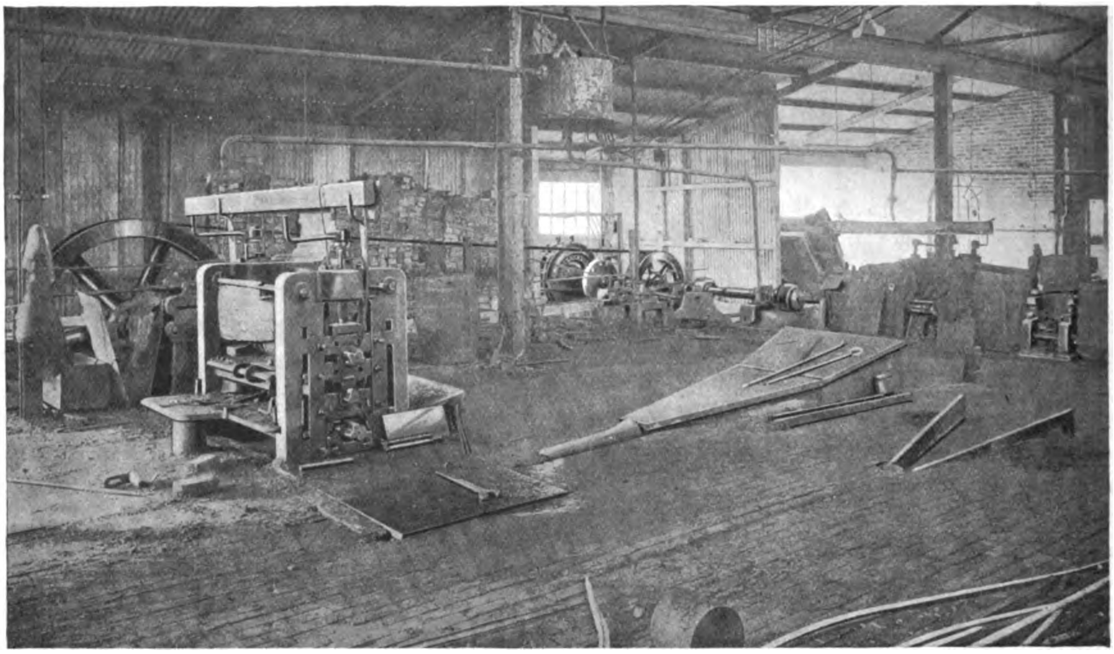


FIG. 2.
150 H.P. 360 R.P.M. INDUCTION MOTOR DRIVING 7" FINISHING TRAIN AND 9" ROUGHING ROLLS.

Continuous mills present special problems in mechanical engineering and have received greater attention and been developed to a greater extent in the United States than in any other country. On the largest scale they are represented by the rail and billet mills in the Gary works of the United States Steel Corporation. On a much smaller scale continuous mills are used for the production of wire rods in large quantities. Perhaps the best-known example is the Morgan continuous wire rod mill for reducing billets about 2-in. square to round wires about 5 or 6 B.W.G. Such a mill consists of

fifteen or seventeen pairs of rolls in tandem, each pair being driven by a pair of bevel wheels from a shaft at right angles to the axes of the rolls. In such a case a heavy flywheel is quite unnecessary, and the motor may be directly coupled to the main driving shaft. The demand for power is comparatively steady and the mill always runs at the same speed, so that from an electrical point of view the problem is a simple one as compared with that presented by a large continuous mill for dealing with heavy ingots or billets of comparatively short length.

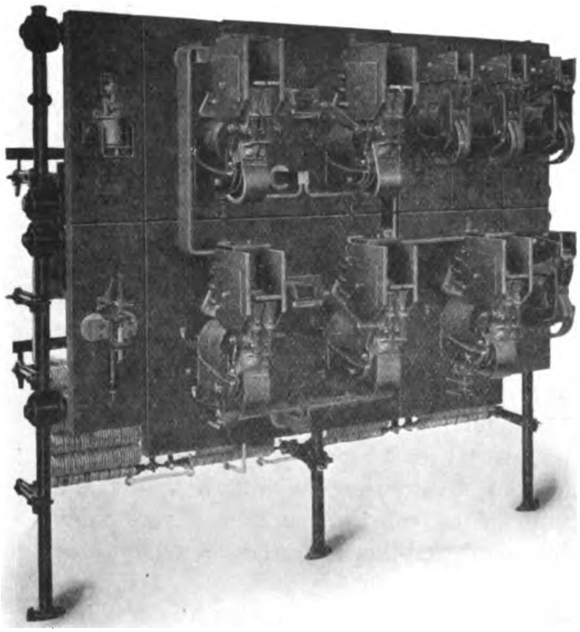


FIG. 3.
AUTOMATIC STARTING AND REVERSING RHEOSTAT FOR 1000 H.P. 460 VOLT D.C. MOTOR FOR TYRE MILL.

When larger outputs are required than can be obtained from a mill of the type shown in Fig. 2, and any given section may be rolled in large quantities, the single roughing stand there shown may be replaced by a number of two-high stands arranged in tandem and connected to the motor by suitable gearing. The same motor may be arranged to drive separate sets of intermediate and finishing rolls. If the intermediate and finishing rolls are not separate, but are coupled together in one line, a convenient arrangement is to connect the motor directly to them and drive the roughing stands by ropes running on to a suitable flywheel, as shown in Fig. 2. Should the intermediate and finishing trains be separate and designed to run at different speeds, it may be necessary to connect the motor to the flywheel shaft of the roughing train either directly or by suitable gears, and drive the intermediate and finishing trains by ropes. An alternative arrangement is to use a separate motor for each train or to connect the intermediate and finishing trains to a common motor by suitable gearing.

Continuous and semi-continuous mills are only suitable for the execution of large orders, and cannot be profitably used for general jobbing work where the individual orders are small and varied. Hence outside of wire works they are seldom seen in this country. Where orders are distributed by Kartel, as was the case in Germany, there is a wider field for them. As it is, the majority of jobbing and merchant mills are of one or other of the first two types described; and as the finished product of such a mill may be anything from $\frac{3}{8}$-in. or $\frac{1}{2}$-in. rounds or squares up to $1\frac{1}{2}$-in. hand rounds or medium angles or channels, it is evident that a wide range of speed adjustment is necessary for satisfactory and economical operation. The first difficulty introduced by this requirement is a mechanical one in connection with the flywheel, and lies in the fact that at the lower speeds at which the heavier sections are rolled, and where the demand for power is greatest, the stored energy in the flywheel is very much less than at the higher speeds used for the easier work of rolling the smaller sections. From an electrical

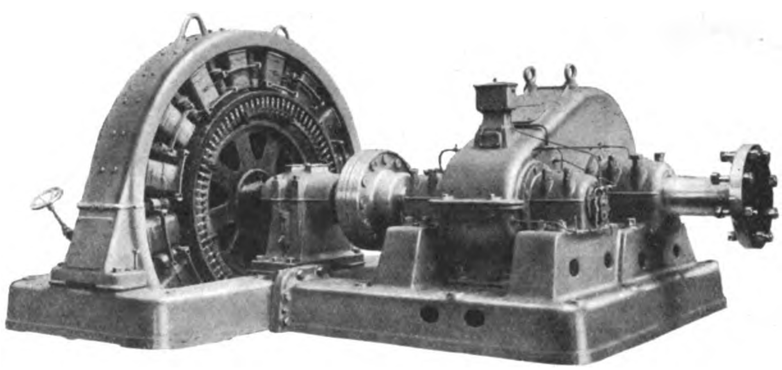


FIG. 4.
1000/2000 H.P. 175/350 R.P.M. D.C. MOTOR AND REDUCTION GEAR FOR TYRE MILL.

point of view there is no difficulty in obtaining a fairly wide speed range with minimum and maximum speeds in the ratio of 1 to 2 or 2½, if continuous current is available; but there is no really economical and satisfactory means of regulating the speed of 50 or 60-cycle polyphase alternating-current induction motors over the same range. In such cases the best results are obtained by using a rotary convertor to

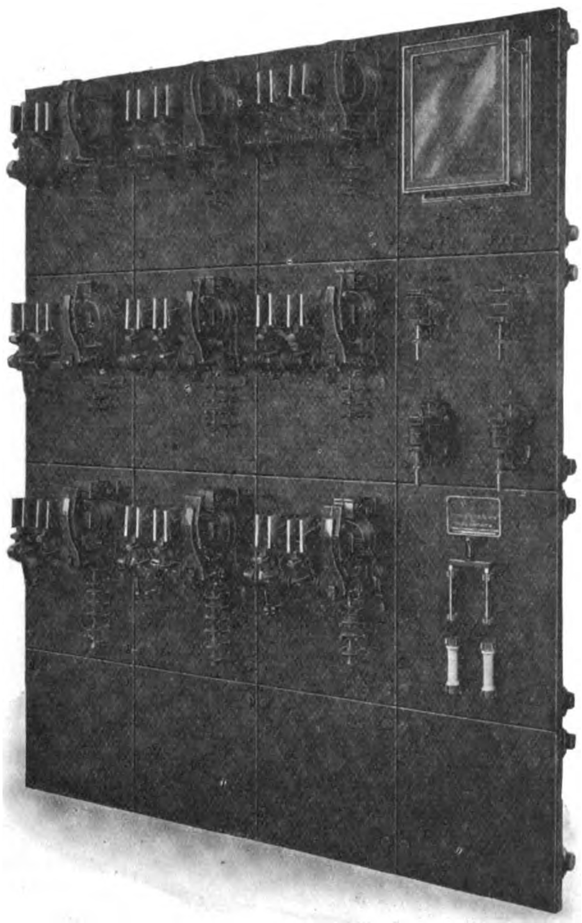


Fig. 5.

AUTOMATIC STARTING AND REGULATING RHEOSTAT FOR 400 H.P. INDUCTION MOTOR.

supply continuous current to a continuous current mill motor. With a 25-cycle supply it is possible to secure satisfactory regulation of an induction motor down to two-fifths of the maximum speed; but at the lower speeds the efficiency becomes less than that of the combination already mentioned, namely a rotary converter and an adjustable speed continuous current motor.

The problem of the economical speed regulation of large induction motors over a wide range of speed is one that is receiving a large amount of attention from electrical engineers, and may shortly be solved.

Sheet and tin-plate mills form a class by themselves both from mechanical and electrical points of view. The speeds are so slow, *viz.*, from 26 to 32 r.p.m., for sheet mills, and 34 to 40 r.p.m. for tin-plate mills, that the use of a direct-coupled motor is not generally a commercial possibility; and the interposition of some form of speed reduction gearing between the motor and the mill is a necessity, more especially in those cases where alternating current only is available. The duty is exceedingly severe and the demand for power fluctuates with extreme rapidity over a very wide range.

In order to prevent the incidence of sudden and heavy overloads on the motor and supply mains and to maintain a reasonably steady speed, the flywheel of such a mill must be capable of storing a large amount of energy. The question then arises as to whether it is desirable to use a comparatively small and light high-speed flywheel coupled to the motor shaft, and transmit the whole of the power required to drive the mill through the speed reduction gearing; or to use a large and costly flywheel directly coupled to the mill shaft, and design the reduction gear to transmit only the maximum power of the motor. In view of the tendency to force the working, and increase the strength of the various parts of sheet mills, the latter is the safer plan unless the gear can be made of such a strength as to transmit the maximum load, which may be applied to it without injury to itself.

In many sheet and tinplate works the motors are connected by ropes to heavy flywheels coupled directly to the mills, but this arrangement has several objectionable features, chief among which are the heavy charges for the maintenance of the ropes and the well-known inefficiency of rope-drives when working at light load as well as the considerable amount of space required.

The starting and regulating devices for the powerful motors used in rolling mills present special problems, and it is becoming an increasing practice to replace the liquid rheostats formerly in general use by suitable arrangements of electrically operated switches or contactors, very

similar in construction and design to those which have given such general satisfaction in heavy traction service. Control gears of this type possess many advantages, among which may be mentioned :—

(1) They are automatic in their action, and the largest motor can be started by closing a small switch.

(2) The starting current cannot exceed a prescribed maximum value.

(3) They require practically no attention, such as must be given periodically to liquid rheostats.

(4) The wearing parts are cheap, have a long life, and can be very quickly replaced.

The motor itself and a reduction gear for connecting it to a tyre mill are shown in Fig. 4. In this case control and reversal of the motor is effected by a small and easily operated master controller fixed quite close to the mill.

A similar rheostat for starting and regulating a 400 H.P. induction motor is shown in Fig. 5. In this case there are nine double pole contactors, five of which are used purely for starting and four for starting and regulating. The starting switch is mounted at the bottom right-hand corner of the panel, with the current limiting relays immediately above. At the top right-hand corner there is a sensitive high-speed relay for opening the contactors in turn, and thus inserting resistance in the rotor circuit whenever the load on the induction motor reaches a prescribed limit.

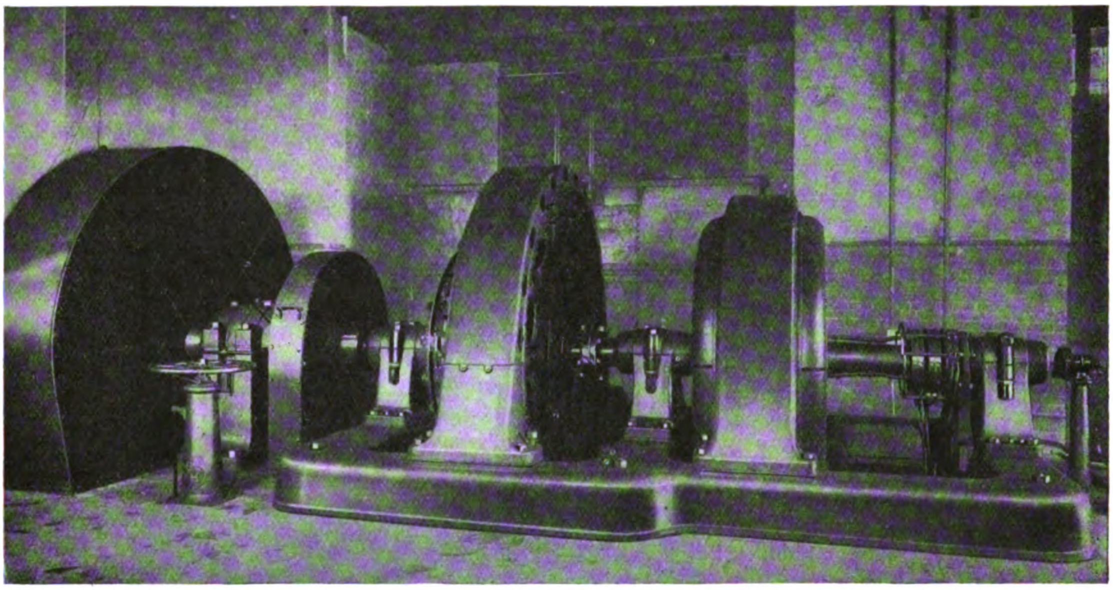


Fig. 6.
1000/3000 K.W. 400/480 R.P.M. FLYWHEEL MOTOR GENERATOR SET.

Fig. 3 shows a starting and reversing rheostat for a continuous current motor of 1,000/2,000 H.P. 175/350 r.p.m. 460 volts, with five starting contactors and four reversing contactors, the latter being interlocked both mechanically and electrically, so as to obviate all danger of a short circuit. It is provided with current-limiting devices, an overload relay which opens all the contactors and inserts the resistance in the armature circuit in case a large overload should be applied to the motor, and a field strengthening relay which automatically strengthens the field whenever it is necessary or desirable to start and run up to any speed above 175 r.p.m. without making any alteration to the adjustment of the field rheostat.

It is customary to obtain the necessary speed drop, to make the flywheel effective, by inserting in the rotor circuit, either a permanent resistance sufficient to give 8 to 10 per cent. slip at full load, or a motor-operated liquid rheostat. Such a permanent resistance reduces the efficiency of the motor by 5 to 7 per cent., and is therefore objectionable. The motor-operated type of liquid regulator only inserts resistance in the rotor circuit as and when necessary; but it is sluggish in its action and quite unsatisfactory when the demand for power fluctuates rapidly between wide limits, as in the

case of motors for driving sheet or tin-plate mills; whereas the contactor type of regulator, as described above, is practically instantaneous

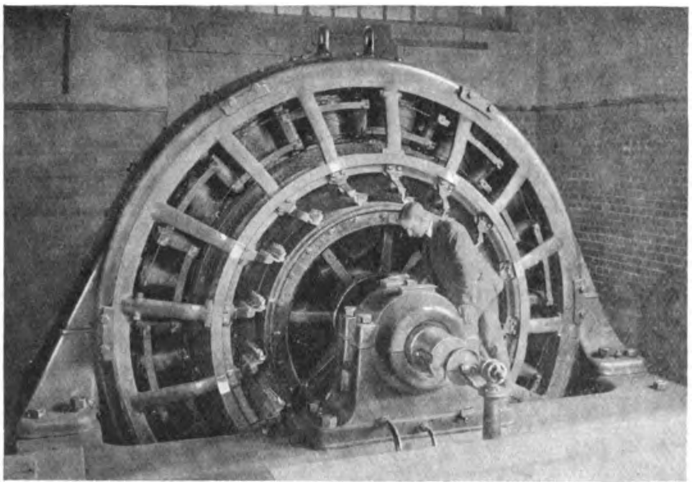


FIG. 7.
1200/3600 H.P. 70/100 R.P.M. D.C. MOTOR FOR 28" COGGING MILL.

in its action, and, moreover, requires very little power.

Control gear of the contactor type is used in conjunction with the large induction motors installed in the Gary works of the Indiana Steel Co. Some of these machines are capable of exerting 6,500 H.P. continuously, and 20,000 H.P. for short periods, and are undoubtedly the most powerful in the world.

From an engineering point of view the electrical driving of the large two-high reversible mills so generally used in Europe is a much more difficult problem than that presented by any type of non-reversible mill. Consider, for instance, a 40-in. cogging mill for reducing 3-ton ingots to 4-in. square billets; a mill of this size is capable of an output of 60 tons per hour if it can be driven at any speed up to 120 r.p.m. To do this there will be required a motor capable of exerting about 15,000 H.P. at 60 r.p.m., and approximately the same power at any speed up to 120 r.p.m. The motor must be capable of running steadily at any speed; and reversal from, say, 30 r.p.m. in one direction to 30 r.p.m. in the opposite direction must be effected in 2½ or 3 seconds.

Obviously the use of ordinary rheostatic control gear is out of the question, and, moreover, the operating conditions are such as can only be satisfied by the use of continuous current and the Ward-Leonard system of control. In this the whole of the regulation and reversal is made to depend on the adjustment of the comparatively small current required for exciting the field of a generator, or generators, of suitable capacity, which are usually driven by an induction motor, and coupled to flywheels designed to equalize the demand for power and prevent the incidence of excessive loads on the power supply system. In the particular case under consideration this motor should have a normal rating of 2,500 to 3,000 H.P., according to the capacity of the flywheels and the degree of equalization desired. With flywheels capable of storing energy to the amount of 125,000 ft. tons at full speed, and a suitable contactor type regulator of the type described above, the power required would probably fluctuate between 2,200 and 3,000 H.P. during the reduction of each ingot.

With turbo-generating plant of modern design the amount of steam required to drive

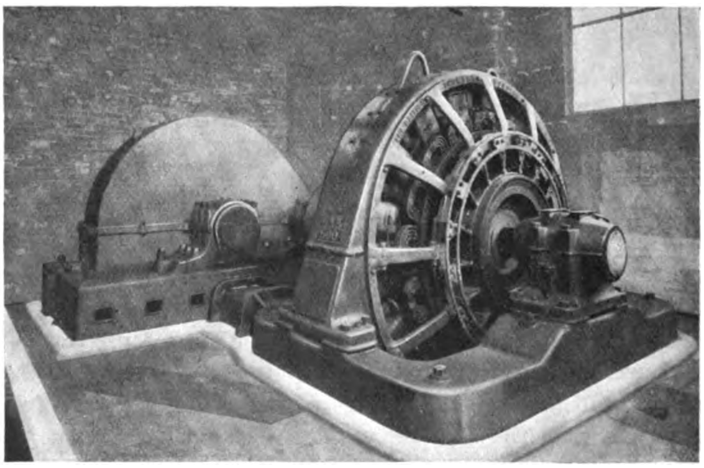


FIG. 8.
600/1800 H.P. 117/165 R.P.M. D.C. MOTOR AND GEAR FOR 24" COGGING MILL.

this mill would be approximately 26,000 lbs. per hour. If a compound-condensing engine were used for the same duty the steam consumption would be about 36,000 lbs. per hour, and the

conditions under which it would be generated and supplied to the engine so much less favourable, that the amount of water evaporated per lb. of coal would be very much less. Indeed, the coal consumption for the turbo-generating plant would probably be little more than one-half that of the steam engine. Against this large saving there are to be placed the higher charges on account of the greater capital cost of the electrical plant, which, however, must be credited with lower standby losses and much smaller charges for repairs, maintenance, attendance and stores. As regards reliability, the electrical firms which have pioneered in this branch of engineering have now had so much experience that their products are in no way behind those of their rivals, the steam engine builders. It is therefore possible to advance very strong arguments in favour of the complete electrification of any new steel works and rolling mills, or even existing works now driven by steam engines.

Whether it is through ultra-conservatism or the difficulty of raising capital to effect the necessary changes, progress towards the complete electrification of the rolling mills and steel works in the United Kingdom has been very slow, and the number of reversible rolling mill equipments installed may almost be counted on the fingers of one hand.

The first equipment of purely British manufacture and design was a double one for the cogging and bar mills in the works of Sir A. Hickman & Co., Ltd., and this was quickly followed by the equipment of the 28-in. cogging mill in the Britannia Works of Messrs. Dorman, Long & Co. The flywheel motor generator consists of a 650-H.P. 480-r.p.m. slip ring induction motor, coupled to a reversible compensated commutating pole generator with a normal rating of 1,000 K.W., and is shown in Fig. 6. The set is connected by a steel spring flexible coupling to a flywheel 11 ft. 6 in. diameter, weighing 30 tons, and provided with substantial brakegear with compound levers and cast-iron water-cooled brake blocks. The flywheel bearings are water-cooled and arranged for both ring and forced lubrication. The mill motor (Fig. 7) is directly coupled to the pinions and is capable of carrying frequent loads up to 3,600 H.P. at any speed between 70 and 100 r.p.m. This equipment has now been in operation about seven years.

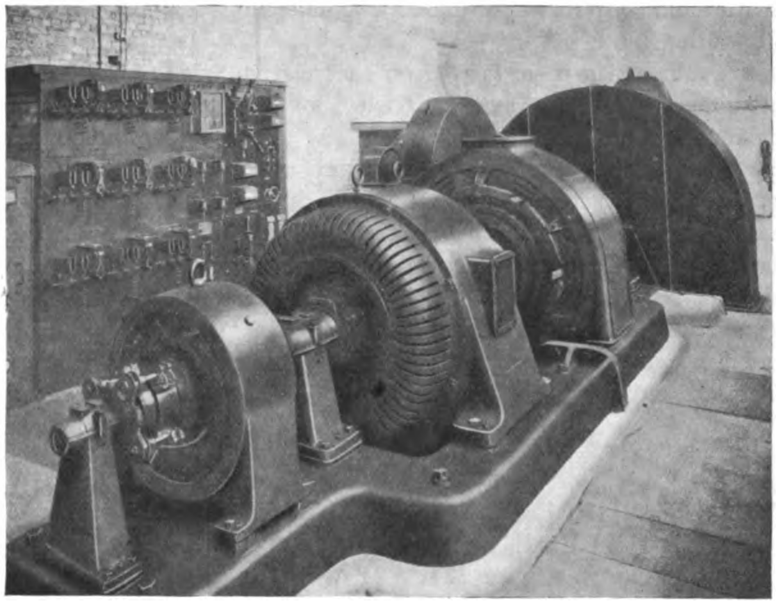


FIG. 9.
500/1500 K.W. 600/750 R.P.M. FLYWHEEL MOTOR GENERATOR SET AND SWITCHGEAR.

A more recent installation, also of purely British origin, is shown in Figs. 8 and 9. The mill motor has a normal rating of 600 H.P., and is capable of carrying frequently applied loads up to 1,800 H.P. at any speed between 117 and 165 r.p.m. It is connected to a 24-in. cogging mill by double helical gearing with a ratio of 3·25 : 1.

The motor generator set consists of a 400-H.P. 6,600-volt induction motor with a synchronous speed of 750 r.p.m., directly connected to a compensated commutating pole generator capable of giving an output of 1,500 K.W. at 440 volts at any speed between 600 and 750 r.p.m., and an exciter for supplying current to the generator and mill motor field windings. The motor generator set is connected by a flexible coupling to a cast steel flywheel 7 ft. 6 in. diameter, weighing 15 tons.

The speed of the flywheel set is controlled

by a combined starter and regulator of the contactor type, as previously described, and visible in the back-ground of Fig. 9. This equipment has now been in operation for one year.

It will be noted that the continuous current machines required for reversible rolling mill drives are all provided with commutating poles, and generally also with compensating windings. These features are essential, and the production of satisfactory machines without them would be quite impossible as a commercial proposition.

Much has been written on the relative advantages of steam and electricity for the driving of rolling mills, but in very few cases are the running charges of a steam plant segregated in such a manner that they can be used as a basis for a strict comparison ; and in fewer cases still are they permitted to become public property. There is no doubt that such segregation is extremely difficult in a steam plant, and it is a great misfortune not only to electrical engineers, but also to the iron and steel trades.

THE FUTURE OF BRITISH ENGINEERING: The Publicity Campaign of the B.E.A.M.A. Trade Committee.

The intention of this Committee, as announced, was to bring propagandist influence to bear in three directions.

Firstly : While public gratitude is lively for the salvation of Europe by the intensified munition manufactures of the British engineering works, and while the rapid extension and organization of those works is a freshly observed phenomenon, it was felt to be timely and prudent that some of the consequential logic of the situation should be brought home to the people, so that in any modification of the trade policy of the nation, due recognition may be given to the vital importance of the Engineering Industry.

Secondly : As the beneficial application of the principle of trade association had already been evidenced to the satisfaction of B.E.A.M.A. members, and as it was seen that powerful commercial combinations abroad had been a threatening feature in international competition before the war and were likely to be even more dangerous in the future, it was decided that in so far as the propaganda concerned the activities of engineering manufacturers, some effort should be made to show the necessity for co-operation on an adequate basis for tuning up the general efficiency of production and for exerting collective power in more vigorous exploitation of foreign markets.

Thirdly : The propaganda included an appeal to the buyer, whether as representative of public authority or private interest, to remember what British engineering had done during the crisis, and to draw the wholesome inference that the purchase of machinery of alien manufacture was and will be injurious to the commonwealth.

The direct national and imperial value of a campaign for such a threefold purpose is certainly now more widely admitted than when the B.E.A.M.A. Trade Committee started its work.

Various proposals offering choice of alternative methods were considered by the Committee at the outset. Those first decided upon were the holding of a series of meetings in the principal cities and the distribution of pictorial leaflets and post-cards affording pointed illustration of the national significance of engineering progress.

DISTRIBUTION OF LITERATURE.

The literature prepared under the authority of the Committee is of practically universal application ; that is to say, it may usefully be distributed almost anywhere and to anybody. The more inhabitants of the United Kingdom grasp the meaning of the simple but very telling sentences which are displayed in this first series of printed matter the more likely is it that the claims of the engineering industry will obtain the due recognition sought by the promoters of this campaign.

There are still substantial stocks available, and quantities may be obtained by application to the B.E.A.M.A. offices. These first specimens may suitably be followed presently by other literature of perhaps more argumentative character ; but for popular consumption in the first instance it is of great importance that the connection between the engineering industry and imperial power and prosperity should be presented rather in the form of a few strong texts than in that of a series of sermons.

MEETINGS.

Those, however, who are, so to say, more advanced students of current economic history have been addressed on that assumption at the meetings held in, so far, five leading cities.

Nothing quite like this campaign has ever occurred before. Meetings concerned with aspects of the commercial future of the country have, of course, been common; but even when addressed by men of genuine public reputation, they have been on a small and moderate scale. It would not usually be expected that such a meeting would attract more than a handful of people or receive more than a summarized paragraph in the local press. The B.E.A.M.A. meetings have attracted remarkably large audiences and the newspaper reports have occupied many columns of the London and provincial daily journals and of the trade and technical press. No comparable meetings held outside London with motives of commercial betterment have been brought so widely and so forcibly before the public mind. The causes of this gratifying success are worthy of brief examination.

Without discussing what may be termed the technical work of organizing such meetings, it is essential that those engaged in the promotion should themselves have a just appreciation of the public interest of the propaganda which they are furthering. In this case, everybody concerned held the firm conviction that the future of the engineering industry is important enough for anybody to talk about and for anybody to hear about. And as the B.E.A.M.A. sought no special credit for itself, but was only too ready to accept the help of any local institution we have had in those cities the invaluable advantage of association with organized bodies possessing local following and public respect.

At Manchester the invitations were issued in the name of the Council for the organization of British Engineering Industry whose executive worked with great energy and success to attract a large audience and to arrange a strong programme. At Newcastle the North-East Coast Institution of Engineers and Shipbuilders provided the platform, and at Glasgow we were able to announce that the meeting had the support of the Institution of Engineers and Shipbuilders, the Scottish Iron and Steel Institute and the Glasgow Chamber of Commerce.

At Birmingham and Liverpool, while there was no similar alliance, and the work of organization was carried out solely on behalf of the B.E.A.M.A., we found powerful local friends as soon as the object of the meeting was privately made known.

The subject titles of the opening address under which the meetings were announced were as follow:—

Place & Date.	*Title.*	*Chairman.*
Birmingham, Feb. 23rd.	Engineering Industry and Public Policy.	Mr. F. Dudley Docker, C.B.
Manchester, March 21st.	What after Munitions?	The Lord Mayor.
Newcastle, April 7th.	The Business Side of Science.	Col. Saxton White (Armstrong, Whitworth and Co.).
Glasgow, May 16th.	Engineering Industry in the Economic War.	The Lord Provost.
Liverpool, May 24th (Empire Day).	Engineering for the Empire.	The Lord Mayor.

Reports of the first three are available in pamphlet form and have already been in active demand. The five addresses are also published in volume form by Messrs. Simpkin, Marshall, Hamilton, Kent & Co., with a general introduction, under the title of "The Coming Crash of Peace."

Over 2,000 people attended these meetings and many more thousands must have read the newspaper reports. Other leading cities are yet to be visited, and in the smaller towns dates can be arranged for meetings of either the character of a business conference or popular exposition.

EFFECTS.

Those who have given sympathetic attention to the work so far accomplished by the B.E.A.M.A. Trade Committee may recognise that the objects sought appear to be somewhat nearer than they were six months ago. There is a noticeable hardening of public opinion on the question of enemy trading in machinery. There is an improving disposition towards the right principles of trade associations. There have been Committees appointed by the Board of Trade to recommend measures of encouragement and protection for British staple trades after the war. But it is naturally impossible to trace a line of causation; the B.E.A.M.A. propaganda can only act as a tributary to the stream of public thought and opinion, and it can only be judged as to its effects by observing whether what has been emphasized in its spoken and written message has in the interval gained in general acceptance.

The meetings have been addressed by directors of great engineering companies, by

chairmen and officials of municipal committees, by eminent consulting engineers and by University professors, all of whom have been very ready to help in such a cause and have expressed their appreciation of the B.E.A.M.A. campaigning effort.

A VALUABLE RESOLUTION.

Particular attention should be drawn to the resolution passed at the Liverpool meeting on Empire Day, not merely because of its terms, but because it was moved by the Chairman of the Liverpool Corporation Tramways and Electric Power and Light Committee (Councillor E. Russell-Taylor), and seconded by the Chairman of the Manchester Corporation Electricity Committee (Alderman W. Walker) :—

> " That the indispensable military service rendered by the engineering industry and its fundamental importance in the future as the basis of defensive power and of prosperous economic development entitle it to special state recognition in any reform of national and imperial commercial policy, and to the patriotic support of all public and private users of plant and machinery throughout the Empire."

The objects pursued by the B.E.A.M.A. Trade Committee could scarcely be stated more concisely than in the language of this resolution.

T. C. E.

UNITED BRITISH INDUSTRIES ASSOCIATION.

The first meeting of this Association will be held July 20th, to consider plans and to decide on a policy. At present the members consist of upwards of one hundred individual firms and Associations who have agreed, provided they approve of the policy, to pay a subscription of £1,000 to form a nucleus for work. Messrs. F. Dudley Docker, J. F. Nettlefold, W. P. Bylands and also Mr. F. R. Davenport and Mr. A. W. Tait are to be congratulated upon the accomplishment of a co-operative effort which involved sinking the personal differences of the rival interests of *The Institute of Industry*, "*The Central Organization*" and *Mr. Dudley Docker's group*. The result is, indeed, a justification of the action taken by these different groups in order to promote a movement for National Security.

As the general lines of policy will be laid down at the first meeting, we hope that all will agree on the necessity of including Labour in the membership and councils of a body that is being formed for the benefit of British Industry. If the majority follow the lead of Mr. Dudley Docker, they will desire to find means to lessen the senseless antagonism between Labour and Capital, and to use their experience in reconciling these really identical interests. Speaking of this Association, he recently said, "*I trust it will be the happy means of bringing together into a partnership which can only be for mutual good—Capital and Labour.* At the front, in the trenches, such a one exists, and, when the battle is won, should not this partnership be consummated at home ? " If this be the wish of the members of the United British Industries Association, it may become in truth a united association of British industries and will achieve a service in the National cause so great that it would be impossible to say what might be the result.

All the varied interests in the country which we have enumerated before in this connection should be gathered together in an association of this kind ; Trade Associations, Employers' Associations, Trade Unions of Labour, Scientific Institutions, Agricultural Co-operative Societies, and Financial Associations are all inter-related and must meet "round the table" before any effective work for improving the conditions of industry in this country can be begun. Mr. Dudley Docker says, in fact, that "we hope all existing and kindred Associations, great and small, will be connected with us in more or less intimate relationship."

The Trade Associations of the separate industries are the result of much organization and a thorough representation of Trade Associations would constitute a strong body based on the organization already accomplished and would secure a more representative body for a National programme than is possible by an association of individual firms.

The Grand Council of such an Association will be able to deal only with general policies ; it will require competent committees to do the actual work of the various departments. Also, the success of the whole venture may depend on the man chosen to direct its affairs. He must be supported by a thoroughly efficient staff, but on his motives, experience and vision of the national needs will rest largely the ultimate success or failure of this new undertaking to meet the present new industrial conditions.

THE USE OF ELECTRIC DRIVING IN INDUSTRIAL WORKS. By FRANK WALKER.

In previous numbers of The Beama Journal several articles have appeared designed to give to non-technical readers some assistance in making the best possible choice of motors and control gear to suit any particular purpose in industrial work.

The present article is designed to supplement those preceding it by reviewing in a general way the considerations that determine the suitability for electric driving of any industrial works, the choice between direct and alternating current, the choice between taking energy from a public electricity supply undertaking and the installation of a private generating plant, and also a number of considerations affecting the choice of prime movers.

It is hoped that this article will be of service particularly to managers of industrial undertakings, to many of whom responsibility for the installation of electric driving or of new power plant may occur only seldom in a lifetime, and who naturally cannot be expected to be familiar with all the considerations that should be taken into account.

Under the present state of affairs in very many industrial works, the mind of the management appears, not unnaturally, to be focussed mainly upon processes and affairs that more nearly touch the legitimate product of the works ; little or no attention being given to the existing power plant, so long as the wheels are kept turning and the working costs are kept within the customary limits.

The main engines in such power plants are often looked after in a manner that does credit to their attendants, but, nevertheless, so great is the increased efficiency obtained in new types of engines by improvements in the art made during the last twenty years, that the saving to be effected by purchasing electrical energy or by substituting engines of a modern type would soon repay the necessary outlay.

In addition to the main engines, the power plant will include mechanical transmission gear, comprising—Belts, ropes, gears, shafting, etc., and the driven machines, and also in many cases auxiliary engines and steam pipes leading thereto. Experience shows that friction losses in the mechanical transmission gear and in the driven machines, as well as losses by condensation in steam pipes, often absorb an altogether disproportionate amount of the total power generated, even in installations that are carefully looked after ; and where this is not the case, examples of friction and condensation losses are quite frequently met with that to anyone familiar with the possibilities of electric driving are very startling.

Although the application of electric driving already made is certainly very great, there are yet vast numbers of industrial works in which the electric drive might easily be made the means of effecting very important economies.

A possibility that should be freely recognised, in the best interests of everyone concerned, is that under certain favourable conditions, such as are obtained in a few special industries, a better return for the capital invested may sometimes be obtained without electric driving than with it. These conditions include a load factor* of 80 to 100 per cent., assuming continuous day and night running, a compact plant with small friction losses in transmission, low costs for fuel and land, and for steam plants a plentiful and inexpensive water supply.

The special industries where these conditions may obtain include chemical works with a load factor of practically 100 per cent., and paper mills working night and day for six days a week, with a load factor of about 80 per cent.

On the other hand facts that should not be overlooked are (*a*) that commercially successful examples of both chemical works and paper mills of large size that purchase all the energy required are to be met with, (*b*) that in paper mills the use of a " Reducing " turbine driving an electrical generator and passing out steam for manufacturing processes helps very much the case for electric driving, and (*c*) that in works where electric driving throughout may not be a commercially sound proposition, important savings can be frequently be made by substituting electric motors for auxiliary steam engines.

Such engines are frequently scattered about the outskirts of the premises and connected to the boilers by steam pipes of great

* *Load Factor.*—The number obtained by dividing the actual output of a generator or an engine, or of a whole generating station or power plant, during a given period, by the output, if the maximum had been maintained during that period.

length (frequently unprovided with non-conducting covering), in which very heavy condensation losses occur continuously. Such motors could be driven from a generator in the main engine-room or by energy purchased from an independent source of supply.

That very important economies in industrial works can generally be effected by means of electric driving has been stated already, but a further fact must be mentioned, the significance of which is generally only partly appreciated, *viz.*:—that the possibilities of economy operate in a number of different ways. All these possibilities should be considered, though their relative importance will naturally vary according to circumstances.

Elimination of Losses.—The losses that occur in mechanical power transmission take place principally in bearing friction, due to weight of shafts and pulleys and also to tension of belts; in bending belts and ropes round pulleys; in belt slip; and in various types of gearing. Bearing friction is proportionally great in works where much shafting is used, owing to the machines being scattered, and also where the power loads are large, requiring heavy shafts and large belts that tend to pull the shafts out of alignment.

Where all shafting, hangers and belts, etc., are kept in good condition, the friction losses may be about 25 to 30 per cent., but they are generally higher and probably average between 40 and 60 per cent.

In considering the friction losses it is necessary to remember that to keep long line shafts in sufficiently good alignment to prevent undue friction is always a difficult matter, and that when a system of shafts and belting is transmitting power the friction losses are greater than when the system is running with all belts on the loose pulleys.

Transmission losses are specially expensive when a small part of the plant is in use during overtime, requiring that all shafting and belting shall be kept in motion, and thus involving the entire friction load of the plant.

With electric driving separate motors for each machine may be used, or the machines may be arranged in suitable groups with a motor to each group. With the individual drive all friction and belting losses are done away with, and, by stopping any motor when it is not required, the power losses may be reduced to an absolute minimum. Many machines have a load factor below 20 per cent., and in such cases this saving becomes specially important. By arranging the driven machines in suitable groups with a separate motor to each group, advantage may be taken of the "diversity factor"* to install fewer motors of reduced total capacity, thereby obtaining the advantages of smaller capital outlay and reduced capital charges. At the same time short light shafts that are easily kept in alignment can be used for each group of machines, all long heavy line shafting with heavy main driving belts and the accompanying friction losses being done away with.

In addition to the gain resulting from the elimination of losses due to friction, etc., credit must be allowed for important reductions in expenditure for maintenance and renewal of belting, etc., and for lubricating oil and attention to bearings.

Increase in Output.—The output that can be obtained from any given machine depends upon a number of factors, the relative importance of which naturally varies according to circumstances. These factors may be considered most conveniently in the following order:—

(*a*) Cyclic irregularity.
(*b*) Influence of load upon speed.
(*c*) Adjustment of speed to work.

It may be claimed fairly that cyclic irregularity in speed, which occurs with all reciprocating engines, and does not occur with the electric drive, is liable to seriously affect the output obtainable from various types of machines, both as to quantity and quality. By the term "cyclic irregularity" is meant the variation in speed that occurs in reciprocating engines during every revolution, and that is transmitted with more or less of exaggeration to the driven machinery. This effect and its influence upon output will be more easily understood by an examination of the graphic records given on the next page:—

Fig. 1 is a tachograph record taken from a 500 b.hp. tandem compound condensing steam engine running at 75 r.p.m. The speed

* *Diversity Factor.*—The number obtained by dividing the sum of the maximum load of the individual machines driven by any motor during a given period by the maximum load upon that motor during the same period.

remains constant throughout the record and the cyclic irregularity is within 0·5 per cent.

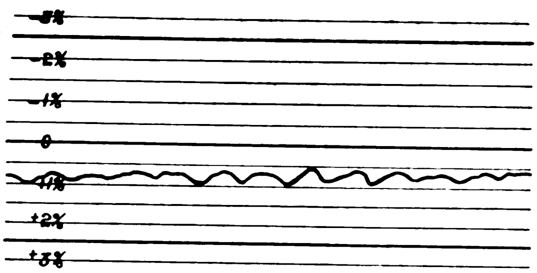


Fig. 1. CYCLIC IRREGULARITY OF 500 B. HORSE-POWER 75 REVS. PER MIN. TANDEM COMPOUND STEAM ENGINE.

Fig. 2 is a record taken from an 800 b.hp. condensing steam engine of the double beam type, running at a speed of 31 r.p.m. The speed remains constant throughout the record, the cyclic irregularity being 3 per cent.

Fig. 3 is a record taken from a 40 b.hp. horizontal gas engine running at about 176 r.p.m., taking gas from a suction gas producer.

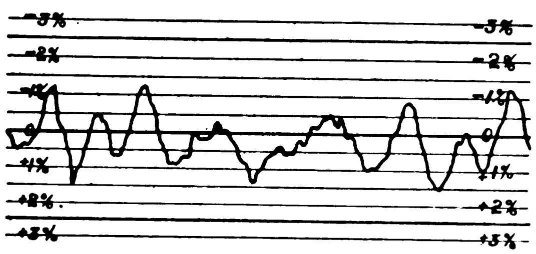


Fig. 2. CYCLIC IRREGULARITY OF 800 B. HORSE-POWER 31 REVS. PER MIN. DOUBLE BEAM TYPE STEAM ENGINE.

The cyclic irregularity is about 6 per cent. The engine is governed on the "hit and miss" principle, the effect of which is clearly shown. During several explosions the speed increases till the governor comes into operation, causing the engine to miss its charge of gas till the speed has become sufficiently reduced.

Fig. 4 is a record taken from a 750 b.hp. gas engine of the vertical tandem type, running at 200 r.p.m. The speed remains constant throughout the record, the cyclic irregularity being within 0·5 per cent. It is noteworthy that in this engine the governing is by variable admission.

The illustrations given in Figs. 1 to 4 will suffice to indicate the cyclic irregularity that occurs in various types of reciprocating engines, and at this point reference may be made to the success that has attended the application of steam turbines with suitable speed reducing gear as a prime mover to give a direct mechanical drive, and it may be mentioned that the cyclic regularity of the turbine, like that of the electrical motor, is perfect, because of the entire absence of reciprocating parts. As is shown in the illustrations, the initial irregularity at the engine crankshaft may be quite a small percentage, but the fact that this irregularity becomes exaggerated in the shafting, belts, ropes, and gears, forming the mechanical transmission system between the engine and the driven machine, multiplies its importance

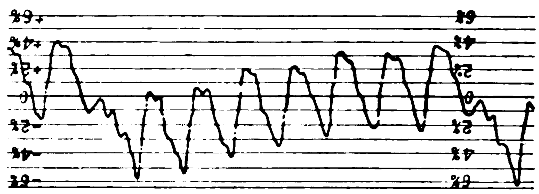


Fig. 3. CYCLIC IRREGULARITY OF 40 B. HORSE-POWER 176 REVS. PER MIN. HORIZONTAL SINGLE-CYLINDER GAS ENGINE, WITH "HIT AND MISS" TYPE GOVERNOR.

very greatly. This is evidenced by the fact that tests at the shaft actually belted to the driven machine sometimes show a cyclic irregularity of over twenty per cent.

An example of this effect is given in Fig. 5.

Record A is taken from a compound horizontal engine developing about 300 b.hp., the cyclic irregularity being about 1½ per cent.

Record B is taken at a point to which power from the engine was brought first by a

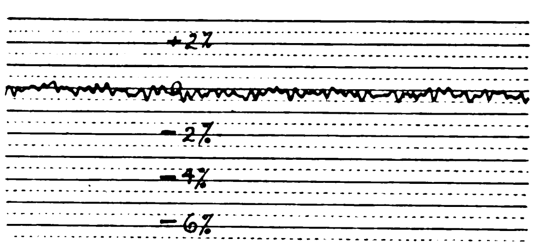


Fig. 4. CYCLIC IRREGULARITY OF 750 B. HORSE-POWER 200 REVS. PER MIN. VERTICAL TANDEM SIX-CYLINDER GAS ENGINE, WITH VARIABLE ADMISSIGN GOVERNOR.

rope drive to the second motion shaft and then along 90 feet of the second motion shaft, the irregularity now approaching ten per cent.

Record C is taken at a point to which power from the engine was brought first through a rope drive on to the second motion shaft. Second along 90 feet of this shaft, third through

a pair of bevel wheels, fourth through 50 feet of vertical shaft, fifth through another pair of bevel wheels, and sixth 40 feet along a horizontal shaft, from which point the drive was taken to a mule spinning room, and, as is shown by the record, the cyclic irregularity now approaches 20 per cent.

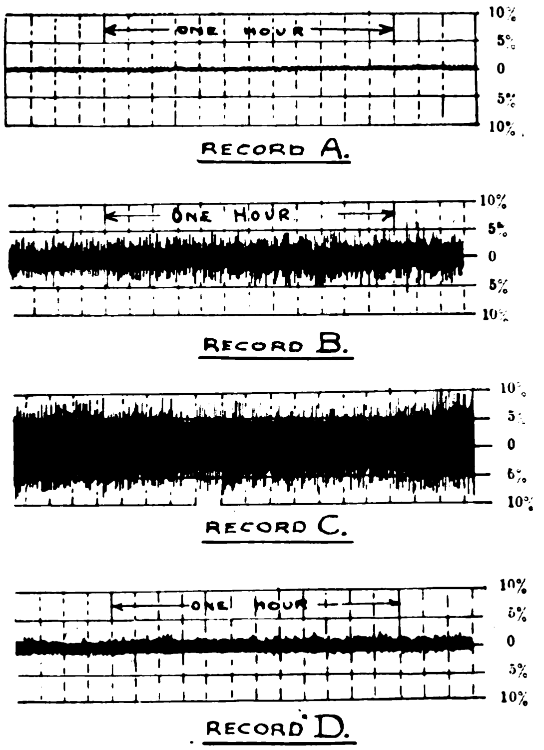


Fig. 5. TACHOGRAPH RECORD SHOWING EXAGGERATION OF CYCLIC IRREGULARITY IN TEXTILE MILL.

In this instance an alternating current induction type motor has been installed to drive all the mules in the spinning room, and record D shows the resultant improvement. The slight irregularity left may be traced to the very

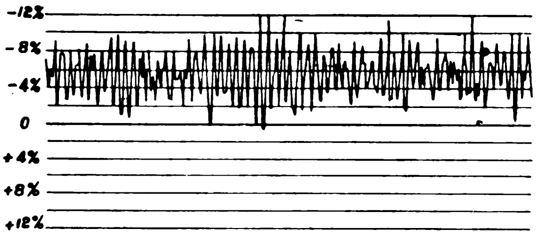


Fig. 6. TACHOGRAPH RECORD, SHOWING CYCLIC IRREGULARITY IN SHAFT DRIVING LOOMS.

irregular load, causing torsional movements in the length of shafting between the motor and the position where the record was taken.

A further example of cyclic irregularity recorded at the ultimate driving shaft is given in Fig. 6, taken from a seventh motion shaft driving looms in a large textile mill.

The shaft being 200 yards from its prime mover, and the power being transmitted through, first—set of spur wheels, second—two sets of bevel wheels, third—one vertical belt drive, and fourth—two horizontal belt drives. In this case, cyclic irregularity in the prime mover, of within about three-quarters of one per cent., has been increased to about 12 per cent. in the shaft under consideration.

Probably the most convincing object lesson in the effect of improved turning moment due to the absence of cyclic irregularity obtained by using the electric drive is to be found in the testimony of textile manufacturers as to from 6 to 25 per cent. increased output, with yarn of better quality and with reduced maintenance and repair bills. When consideration is given to the fact that this increase in output is obtained without any additional labour costs, its significance becomes apparent.

Although textile works afford probably the most striking effect of cyclic irregularity, no difficulty in imagining its effect in other manufactures should be experienced, *e.g.*, in machining operations where the work or the cutting tools are at all springy.

(*b*) *Influence of load upon speed.*—Under this head it will be convenient to consider first the effect upon output of allowing steady loads to be influenced by irregular loads (Figs. 7 and 8).

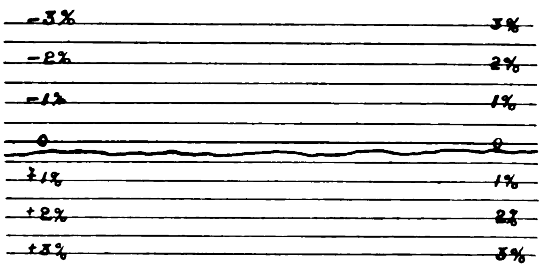


Fig. 7. TACHOGRAPH RECORD OF INDUCTION MOTOR DRIVING RING SPINNING FRAMES.

Fig. 7 gives the speed record of a twenty horse-power a.c. induction motor motor driving a number of ring spinning frames. It should be noted that the cyclic irregularity is nil and that the variation in speed (denoted by the waviness of the line) is negligible. On to this motor, a goods hoist is suddenly connected through a friction clutch, causing

the speed to be affected as shown in Fig. 8, which is a continuation of the previous record. It will thus be evident that the sudden addition

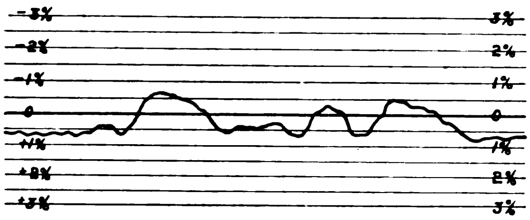


FIG. 8. TACHOGRAPH RECORD, SHOWING EFFECT OF SUDDENLY THROWING ADDITIONAL LOAD ON SHAFT WITH STEADY LOAD.

of such an irregular load affects the speed and steadiness of running of all machinery driven from the shaft in question, if not all the machinery in the concern, and that the influence of such irregularity cannot be other than detrimental to the output.

To further appreciate this effect the operation of machines that take a rapidly varying amount of power, such as spinning mules or looms, should be considered. A diagram showing the power variation in one complete draw by a self-acting spinning mule is given in Fig. 9, which shows clearly that to start the carriage and spindles a "peak" amounting to more than double the power required when twisting, is required.

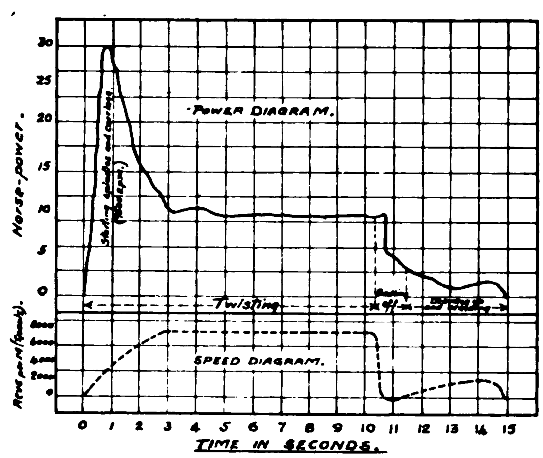


FIG. 9. DIAGRAM SHOWING POWER LOAD TAKEN BY A SELF-ACTING SPINNING MULE.

Usually six mules (*i.e.*, six headstocks with two carriages each) are placed in one room, and the effect upon other machinery in the mill of a number of "peaks" occurring simultaneously may easily be imagined.

With looms, similar "peaks" occur at the operation of the "picking pegs" which send the shuttle bearing the weft to and fro, and again, the simultaneous occurrence of a number of peaks must necessarily affect the steady running of all looms in the weaving shed, as well, possibly, as other machinery in the mill.

With the electric drive this detrimental effect would be minimized owing to the constant speed characteristics of the motors, the turning effort of which adjusts itself to the load almost instantaneously, or, and better still, by putting down separate motors either for individual machines or for different groups, according to the character of the load, such undesirable influences could be done away with altogether.

Another way in which the output may be affected by speed is shown in Fig. 10, which

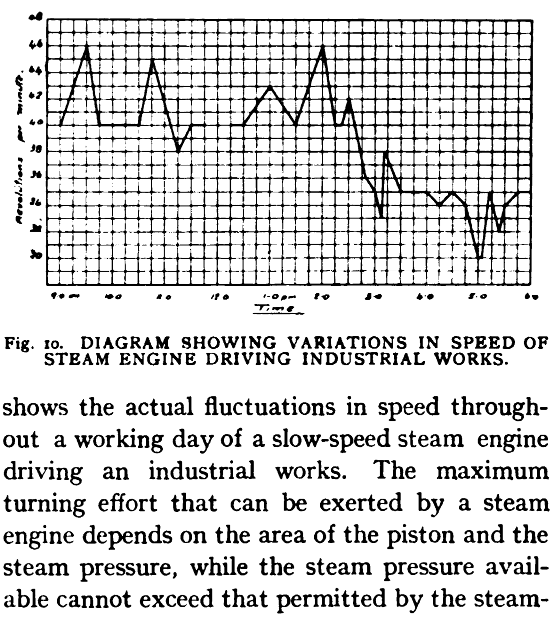


FIG. 10. DIAGRAM SHOWING VARIATIONS IN SPEED OF STEAM ENGINE DRIVING INDUSTRIAL WORKS.

shows the actual fluctuations in speed throughout a working day of a slow-speed steam engine driving an industrial works. The maximum turning effort that can be exerted by a steam engine depends on the area of the piston and the steam pressure, while the steam pressure available cannot exceed that permitted by the steam-raising capacity of the boilers, so that steam engines (as all other prime movers) tend to slow down in speed with an increasing load.

But the output of any machine is, in general, in direct proportion to the speed of its rotation, so that any falling away in speed is accompanied by a corresponding reduction in output, and it is important to note that the reduction in speed in steam engines, etc., takes place when the load is greatest, *i.e.*, when the factory is exerting its maximum earning power.

With the electric drive, the speed is practically independent of the load, the utmost variation between the extremes of no-load and 25 per cent. or 50 per cent. overload usually being not more than about 5 per cent., and

probably less than 2 per cent. within the actual working limits of load.

Consequently full speed and therefore full output is maintained continuously.

An interesting example of the increase in output due to this characteristic of the electric motor is found in rolling mill drive. When steam-driven, marked slowing down occurs as the metal passes through the rolls, but with electric drive the speed is maintained, giving a substantially increased output.

(c) *Adjustment of speed to work.*

In many industries the conditions of work require a fine adjustment in the speed of the machine, as in machine tools, callender rolls, printing presses, textile printing machines, etc. To obtain the required speed variation by mechanical means, stepped "Cone" pulleys or gears are used, which permit generally of only limited adjustment, and this adjustment in coarse steps, so that the machines must be run frequently at lower speeds than is necessary.

For such work the individual electric drive with direct current motors enables the output to be increased appreciably, as by means of field rheostats the speed can be adjusted with any desired degree of fineness.

A further important consideration influencing output is that where coned pulleys are used, belts that are relatively narrow and easily moved must be employed, which results in insufficient driving power on the machine to do the work it is capable of, and much slipping takes place, resulting in loss of production.

These difficulties are entirely overcome by the positive drive that can be obtained by placing a motor close to the driven machine, or preferably as an integral part of it.

Probably the most convincing proof of the increased output obtainable with the electric drive lies in the general experience, in nearly all cases where it is adopted, that an increase of up to 10 or 15 per cent. in the speed of the driven machinery is found to be practicable.

Space and convenience.—Important indirect economies may often be effected with electric driving, by re-arranging the driven machines so as to use space and light to the best advantage, and to secure the progress of the product from the raw to the finished state along the route that best conduces to saving of labour and at the same time to increased economy.

Where the buildings are scattered, motors can be arranged to suit the best convenience without it being necessary to consider the possibility of large losses in transmission.

In machine shops, etc., portable tools driven by individual motors may conveniently be moved to the work to be done, so that on a large piece of machinery several operations may be carried on simultaneously.

Motors can be readily moved from place to place, and when alterations in the grouping of driven machines are desired, they may be made readily and at very small expense.

If extensions are required, the problem of power supply is greatly simplified, where electricity can be purchased from a supply undertaking.

When so desired, the installation of electric driving may be carried out gradually, the general scheme being first decided upon, and the motors installed subsequently at will, the more wasteful drives being replaced first.

The use of electric drive, by eliminating shafting and belting, does away with much vibration, noise, oil, and dust, and gives greater cleanliness and better lighting, thus improving working conditions, with again a resultant increase in output.

Remote and Automatic Control.—With many industrial machines, important saving in labour may be made, and at the same time the output of the machine increased, by enabling the operator to control his machine from several points.

This facility is one made with great ease where the electric drive is used, and in the case of machines such as large printing presses, etc., is a means of effecting most important economies.

Again, it frequently happens that motors require to be automatically started or stopped according to the requirements of some service, and independently of any operator. Such automatic control is now possible with electric motors to a very wonderful extent.

Measurement of Power.—A very important means of effecting economy where the electric drive is used is by means of instruments and meters. At very low cost meters can be installed to indicate the exact performance at any moment of any motor, and, as the efficiency of motors does not diminish with age, the reading shows not only the extent of the load, but the

mechanical efficiency and condition of the driven machine.

Of still greater value, perhaps, is the ease with which an instrument of great accuracy may be connected in any motor circuit and a record made on a slip of paper showing the exact performance of the machine, and incidentally of the operator.

Further, by installing meters to record the supply taken by different departments in a works, records are obtained which form a useful basis upon which measures can be taken to reduce the consumption in each department.

In cases where the use of such devices has been adopted, the reduction in energy consumption that has been found possible has been very considerable, the cost of the instruments being repaid in a few months' time.

Direct v. Alternating Current.—One of the first questions to be dealt with after an electrical installation has been decided upon, is the choice that must be made between the use of direct and alternating currents.

With direct current, motors capable of speed variation between wide limits can be employed, the speed being controlled with great ease and without wasteful expenditure of energy. On the other hand, direct current motors have commutators that regularly require a certain amount of attention, and brushes that from time to time must be renewed.

Other important considerations are that for certain chemical processes direct current is essential, and that only with direct current can storage batteries or " accumulators " be used.

Alternating current induction type motors are generally less costly than corresponding direct-current machines and, being without commutators, require less attention. Slip ring motors have slip rings and also brushes, but the tendency towards sparking is very much less than in direct current motors, so that less attention is necessary, and the brushes require less frequent renewal. Squirrel cage motors have neither commutator nor slip rings, the shaft and bearings being the only wearing parts, so that motors of this type are exceedingly simple and robust machines.

For operation on two or three-phase circuits, induction motors can be built with starting and running characteristics to suit most industrial purposes, motors to run at two or more stated speeds being constructed without difficulty.

For operation on single-phase circuits, the possibilities are more limited, nevertheless important progress in the design of single-phase motors has been made in recent years, and many such motors are in successful operation for varied purposes.

An important advantage obtained with alternating current, is the facility with which the pressure can be raised or lowered to any desired extent by the use of static transformers. Where electrical energy is to be transmitted over any considerable distance, the employment of high-pressure transmission allows the use of smaller cables, with substantially reduced transmission losses and greatly reduced first cost.

*Public Supply Undertaking v. **Private** Installation.*—The problem involved in the choice between taking energy from a public electricity supply undertaking and installing a private generating plant, is the determination of how to obtain the requisite supply of electrical energy, with maximum reliability, and, presumably, in return for minimum expenditure in both costs and supervision. The importance of these factors will vary in different cases, but it should be clearly realized that in practically all cases, losses which frequently assume most serious proportions may be caused by breakdowns of unreliable power plant, and that the importance of costs will vary with the margin available for profit and the relation between the power costs and the total expenditure for wages, etc. Electricity supply undertakings are generally able to offer terms that are most favourable. They are able to do this for various reasons, *e.g.*, they can place large contracts for fuel which they thus obtain at low cost. Owing to the fact that consumers' maximum loads occur at different times, it is found that the maximum demand upon the generating station is usually not more than 40 to 60 per cent. of the sum of the maximum demands of the individual consumers (this ratio being termed the " diversity factor "), which gives the supply undertaking the benefit of low capital charges. Large generating units can be employed, and kept economically loaded. Moreover, the entire plant is kept constantly under expert supervision, and can thus be maintained in a high state of efficiency.

But beside the actual price of energy, various other influential factors must be taken into account. Space that would otherwise be

required for a generating plant is left free and available for extensions. Capital otherwise required to pay for generating plant can be invested in the business. The absence of generating plant eliminates all its upstanding charges. The generating plant of supply undertakings nearly always includes a margin of stand-by plant that ensures freedom from total shut-downs. The management is relieved of power plant supervision and anxiety regarding breakdowns, and is thus enabled to give more attention to the legitimate concerns of the business. The amount of energy consumed in different parts of the works can be measured, and economies frequently effected. The cost of energy is definitely known, and, moreover, the cost is in proportion to the consumption, so that if a single motor be run outside the usual working hours, the energy consumed does not exceed in cost the standard rate that is charged at fall load. In this connection it is important to remember that all generating sets, whether steam or gas driven, are considerably less efficient at light loads than at full load. This falling away in efficiency, and also the proportion of full load consumption taken at no-load by various types of prime movers of the sizes commonly used in industrial works, may be expected to be approximately as tabulated below.

	Capacity K.W.	No load cons. %	Increase % Half load	Increase % Quarter load.	Max. Overload %
Steam Engines ...	200–1000	14	4	22	25
Steam Turbines ...	1000	12 to 19	12 to 19	27 to 47	50–100
Suction Gas Engines...	10 to 25	—	53 to 68	95 to 105	10
Town Gas Engines...	10 to 20	38 to 45	42	—	10
Vertical Engines ...	150-750	28–33	28–33	80–95	10
Large Hor. Engines...	800	—	36–50	105	10
Large Hor. Engines...	2000	—	48	—	3
Diesel Engines ...	10–100	—	27–50	66	10
Diesel Engines ...	150	19–6	17–19	50	10

Further allowance must be made for losses in steam pipes and stand-by losses, both of which are largely independent of the load, and for falling away in efficiency at light loads of steam boilers and gas producers.

Other allowances also must be made for the possibility of increased consumption in the power plant, due to deterioration, or resulting from lack of sufficiently skilled attention, inspection, cleaning, etc.

Experience shows that the consumption actually obtained under working conditions often is considerably greater than that estimated on the basis of the guarantees and the results of official consumption tests. An approximate idea of the probable extra consumption is given by the following table :—

Locomobile	...	50-200 Kw.	100-50%
Steam Engines	...	100-3000 Kw.	50-15%
Steam Turbines	...	1000-10,000 Kw.	15-5%
Gas Engine with producer	...	100-1000 Kw.	20-10%
Oil Engines	...	50-1000 Kw.	6-3%

Private Generating Plant.—Having ascertained the best service to be obtained from a supply undertaking, the possibilities to be obtained by installing private generating plant should be considered.

Under favourable conditions these possibilities may be found to make the installation of private plant commercially the better proposition. Especially may this be so where waste heat is available, as from blast furnaces and coke ovens, or where exhaust steam, as from colliery winding engines, etc., can be utilized, or, again, in industries where a supply of steam for drying, heating, boiling or evaporating is required.

Where no other source of supply is available, a private generating plant is obviously essential. In setting up such a plant a choice of the most suitable prime mover must be made, taking into account the local conditions in each case. This choice is not so simple a matter as formerly, owing to the introduction and great development during the last twenty years of the steam turbine, the large gas engine, and the Diesel engine, all of which merit careful consideration. But, in deciding this question, it is necessary to take into account all the factors of capital and working costs that are involved, of which the principal items that may occur are tabulated below for convenient reference.

Capital Costs.

(*a*) Land.
(*b*) Buildings and Foundations.
(*c*) River work, Railway siding.
(*d*) Boiler and Economisers, Cooling Towers or Ponds, Gas Producers and Recovery Plant.
(*e*) Coal and Ash Plant, Oil Tanks.

(*f*) Turbine or Engine with Generators, Condensers, Pipes, Pumps.
(*g*) Switchgear, Wiring.
(*h*) Cranes, Tools, Miscellaneous.

Capital Charges.

(*i*) Interest to be paid on the Capital costs.
(*j*) Depreciation of the Plant.

Working Costs.

(*k*) Cost of Fuel (including delivery).
(*l*) Oil, Water, and Stores.
(*m*) Wages of Workmen.
(*n*) Repairs and Maintenance.
(*o*) Rents, Rates and Taxes.
(*p*) Management, Salaries, Office and Legal expenses, Insurance, etc.
(*q*) Income due to by-products, etc.

Special Considerations.

(*r*) Reliability.
(*s*) Overload Capacity.
(*t*) Weight and Vibration.
(*u*) Noise and Smoke.
(*v*) Space required.
(*w*) Governing.
(*x*) Quick Starting.
(*y*) Rate of consumption at partial loads.
(*z*) Increased consumption due to deterioration or to want of attention, etc.

The Choice of Prime Movers.—In making comparisons between the different types of prime movers the following points may be noted.

Water Turbines.—The water turbine has been developed to a high degree, and although its application is limited in Great Britain by the small amount of natural water power available. it is an important factor in industrial development in other parts of the world. Owing to the heavy inertia forces of water flowing through long pipes making the sudden closing of valves impracticable, speed regulation has to be effected by either deflecting the water jets, or bye-passing water, and for this reason speed variation of less than 10 per cent. cannot be guaranteed, and alternators to be driven by water-turbines must be designed to run safely at the racing speed of the turbines.

Steam Engines.—Steam engines are generally sold so rated as to run most economically at 75 per cent. of the rated load, and with a guaranteed overload capacity of 25 per cent. Small engines, however, are very often sold on ratings equal to the maximum overload capacity. In ordering steam engines, therefore, the relation between the rating put forward, the most economical load, and the maximum overload should be carefully ascertained.

Steam Turbines.—Steam turbines give probably greater reliability than other types of prime mover. By admitting steam to additional nozzles in turbines having a velocity element, overloads of 50 per cent. or even more can be obtained at practically constant rate of consumption.

When arranged on the oil relay principle, better governing is obtained than with any other type of prime mover.

For maximum loads of 800 kilowatts and above, where the average load, taken over twenty-four hours a day and seven days a week, is not less than 20 to 30 per cent. of the maximum, and with coal at a price of ten shillings per ton, it is doubtful whether any other type of prime mover can compete with the turbine except under extraordinary conditions, or with special requirements. Where coal is cheaper than ten shillings per ton, high-pressure turbines less than 800 kw. capacity may be quite successful competitors. Where low-pressure steam is available, as with winding engines, etc., the mixed-pressure turbine is the only prime mover commercially possible. Again, in works where, in addition to power, steam is required for heating, drying, boiling or evaporating purposes, there is undoubtedly a very great future for Reducing turbines, known in the United States as "Bleeder" turbines. "Pass-out" turbines would be a more appropriate title.

Reference may be made here to the cost of water for condensing purposes. This item is generally small in a properly designed plant, and is largest for plants with cooling towers, which have always to be installed where river, canal or sea water is not available, the cost of town's water prohibiting its use except to a very limited extent and in emergency conditions.

Reference may be made also to the recently developed rotary or jet air pumps for use with condensers, and to the economical results obtained if the air and extraction pumps are driven by a small turbine, the exhaust steam from which is used to heat the feed water.

Steam Plant Auxiliary Apparatus.—To illustrate the importance of proper attention to auxiliary apparatus, reference may be made to results obtained in the Electricity Works at Blackburn, where, within three years, the fuel consumption was reduced from 10 lbs. to 6 lbs. per kw. hour. This improvement was obtained by cutting out superfluous steam piping, by attending to pipes, drains, valves, and dampers, and by the installation and use of CO_2 Recorders.

Gas Engines.—Horizontal gas engines, in sizes up to about 100 horse-power with one cylinder, and twice this amount with twin cylinders, have been developed for a considerable time. They are undoubtedly very reliable machines, but can only be considered for relatively small generating plants. For units ranging in capacity between 150 to 1,000 kilowatts, vertical tandem engines have been developed very successfully during the last ten years. Engines of this type occupy a very small amount of floor space compared with the horizontal type, and, owing to the number of lines of cylinders, a remarkably even turning moment is assured, the reciprocating parts being readily balanced, so that vibration is minimized. The development of the vertical tandem engine has undoubtedly brought the gas engine into much greater favour, and particularly so for use with electrical generators.

Great development has taken place also in horizontal gas engines for large units, a 6,400 horse-power tandem twin engine with a cylinder diameter of 1,300 mm. (51 inches), a stroke of 1,400 mm. (55 inches), and a speed of 94 r.p.m. being under construction at the present time. In this country, however, large horizontal engines have not been a great success, on account of difficulties experienced with the pistons and cylinders.

In ordering gas engines, care should be exercised to avoid misunderstanding regarding the continuous rating and overload capacity of the plant to be supplied, as the overload capacity of gas engines is only in the neighbourhood of 10 per cent. for relatively short periods. A further point is that small horizontal engines are usually rated at their full maximum output, so that a corresponding deduction must be made in order to ascertain the continuous rating.

Gas Producers.—For small gas engines, either town's gas is used, or a suction producer using anthracite or coke is installed. For larger engines, producers able to gasify ordinary bituminous coal have been developed, and owing to the fact that this coal contains a large amount of nitrogen, sulphate of ammonia and tar can be obtained as bye-products by putting in a suitable recovery plant; the income from the sale of the bye-products increasing the over-all economy of the plant quite considerably. In a plant of 2,000 horse-power capacity with constant load, such as is required for electrolytic processes in chemical works, the total cost of producing gas may be reduced by this means as much as 50 per cent.

It should be realized, however, that the installation of a recovery plant involves increased capital charges and increased working expenses for labour, repairs and maintenance, and stores, etc., as well as for coal necessary to produce extra steam that is required for the producer. It will be obvious that to obtain better overall economy the income derived from the sale of bye-products should more than compensate for these additional expenses, and it is doubtful whether the installation of a recovery plant can be made to pay where the average load (24 hours × 7 days weekly) is less than 350 to 500 kilowatts.

Diesel Engines.—Diesel engines operating on heavy oils, such as residual petroleum, refined oils, residual shale oils, natural petroleum or practically any clean fuel oil, offer advantages in needing only a minimum space, there being no boilers, chimneys, etc., as required with steam plants, or the producer plant, as required in the case of gas installations.

An old Lancashire boiler, placed in any convenient position, forms a convenient fuel store, from which a supply sufficient for immediate consumption can be pumped into suitable tanks placed conveniently near to the engine. The rating of Diesel engines is usually such as to give about 10 per cent. overload. Starting is accomplished very simply by merely opening a valve, admitting compressed air into one or more cylinders, this method being identical with that adopted for starting the vertical gas engines referred to above.

In Britain the commercial development of Diesel engines is handicapped by the high price of fuel—gas, oil and crude oil, and the low cost of coal, but it may be that the position has been somewhat improved by efforts recently made to produce Diesel engines suitable for running on tar oil, which is produced in great quantities wherever gas and coke oven plants are in operation, the tar oil being used in conjunction with some such oil as paraffin oil, which is employed for ignition purposes. The consumption of paraffin is equal to about 5 per cent. of the full load consumption, and is independent of the load.

MANUFACTURERS' SECTION

BRITISH THOMSON-HOUSTON CO., LTD.

ROTARY CONVERTERS.

The British Thomson-Houston Co., Ltd., of Rugby, England, were one of the earliest manufacturers of electrical apparatus to recognise the important advantages offered by rotary converters in converting power from alternating current to direct current.

This Company has consistently improved the operating characteristics and details of construction of such machines until they are now installed wherever reliability and efficiency are of prime consideration.

Whether the service is railway or tramway, electro-chemical or industrial, the rotary converter is chosen on account of its high efficiency, large overload capacity, reliability and also its ability to operate on unity or leading power.

Rotary converters are installed either shunt or compound wound, and if necessary, designed to match the characteristics of existing generating machinery. If required to operate over a range of 10 per cent. or 15 per cent. in voltage they are usually installed with reactance control. If the desired range in voltage is, say, 15 per cent. to 30 per cent., then some other form of control must be adopted and the British Thomson-Houston Co., Ltd., will usually recommend the induction regulator type of control, as with this method the commutating characteristics of rotaries are independent of the voltage variation.

Converters have been built in all capacities up to 1,500 KW., and for various frequencies between 25 and 60, and the British Thomson-Houston Co., Ltd., is prepared to build rotary converters of any capacity up to 3,000 KW. and for any voltage up to 2,000 volts for 25-cycle work and 1,000 volts for 50-cycle work.

Whether the machines are designed to be started off transformer taps (as is the case with small machines up to about 200 KW.), or to start by means of induction motors, they are constructed to be self-synchronizing.

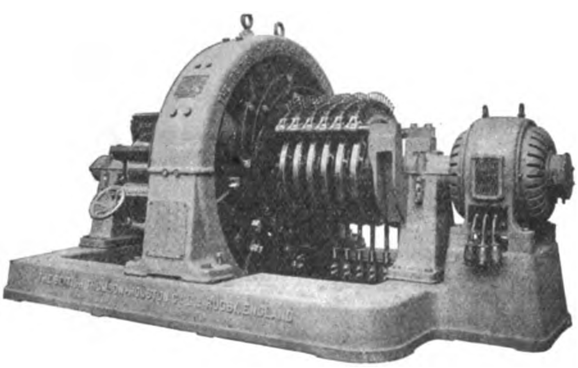


Fig. 1.

1,000 K.W. 500 R.P.M. 50-CYCLE, 6-PHASE COMMUTATING POLE B.T.H. ROTARY CONVERTER INSTALLED IN AN INDUSTRIAL WORKS.

In addition to developing rotary converters so that they are suitable for almost any class of service, the the British Thomson-Houston Co., Ltd., have paid great attention to the improvement of details, and among the special features incorporated in such machines are the following :—

They are equipped with a very efficient form of damping bridge, and hunting has been entirely eliminated, no cases having occurred in recent years.

Commutating poles are of special and liberal design to ensure the greatest stability to commutating conditions.

The armature coils are insulated with mica.

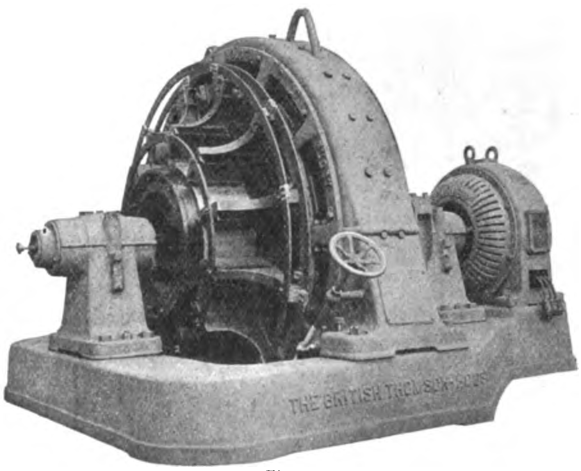


Fig. 2.

600 K.W. 750 R.P.M. 50-CYCLE, 6-PHASE, COMMUTATING POLE B.T.H. ROTARY CONVERTER, INSTALLED IN AN ELECTRO-CHEMICAL WORKS, THIS MACHINE BEING ON FULL LOAD DAY AND NIGHT.

The rings of the armature heads which support the windings are entirely encased in insulation so as to increase the creeping surface to a maximum.

The D. C. brushgear is designed to give a maximum clearance between brush holders of opposite polarity with reasonable commutator speed, and constructed to give accessibility, together with the further advantage, that all working parts, such as springs and adjusting pieces, are thoroughly protected against electrical or mechanical damage.

The sliprings are shrunk on a cast-iron supporting sleeve insulated throughout its range with mica, which has been compressed and ground to size. This method of support avoids all bolted connections (which are liable to come loose) and prevents the sliprings from becoming eccentric, as well as eliminating all joints and insulating washers which are difficult to clean and under which copper dust can accumulate.

The A. C. brushes on all rotaries are of the block type of such a quality that wear is reduced to a minimum, and the cutting that occurs when laminated copper brushes are used is avoided.

The construction of the brush holders enables the whole of the A. C. brushgear to be mounted on the top of the sliprings in the most accessible position, leaving the sliprings quite clear for inspection and cleaning.

The baseplates are specially cast to form a platform round the A. C. brushgear to facilitate inspection and adjustment.

All machines are fitted with speed limit devices and end play devices.

BRITISH WESTINGHOUSE ELEC. & MFG. CO., LTD., MANCHESTER.

DIRECT-CURRENT CONTACTOR STARTERS.

Two novel arrangements of direct-current lock-out contactor starters, which have been developed by the British Westinghouse Company, are illustrated by Figs. 3, 4 and 5. These contactor starters, the smaller sizes of starters these are mounted on a single slate, but in the larger sizes each contactor has its own slate, the whole being mounted on a suitable pipe framework.

The standard service starter consists of a shunt operated contactor fitted with magnetic blow-out (this contactor being controlled by a master switch of either of the types already referred to) and a number of accelerating contactors of the self-closing or lock-out

Fig. 3.

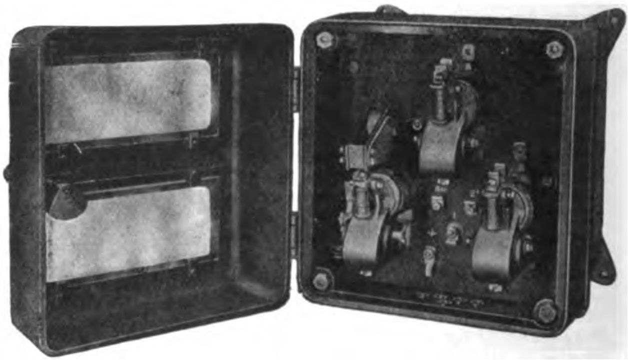


Fig. 4.

TYPICAL OF THE SMALLER SIZES OF BRITISH WESTINGHOUSE DIRECT-CURRENT CONTACTOR STARTERS; NO-VOLTAGE RELEASE ONLY.

Company have designed and are now manufacturing to meet certain particular conditions of service where it is desired to start direct-current motors automatically. Fig. 6 shows another arrangement of contactor starter.

Fig. 5.

BRITISH WESTINGHOUSE DIRECT-CURRENT CONTACTOR, SIZES 4 TO 35 HORSE-POWER.

The starters are intended for use for (1) motor-driven pumps feeding a tank or emptying a sump; (2) motor-driven pumps supplying water at high pressure for hydraulic plant; (3) motor-driven compressors; (4) starting and stopping a motor from a distance. In the case of (1) the starter is controlled by a float switch operated by a float in the tank. The level of the water governs the opening and closing of the float switch. In the second case a tappet switch is operated by the rise and fall of the hydraulic accumulator. In case number (3) an air governor switch is supplied, which is operated by the rise and fall of pressure in the air system; while in the case of (4) the control is by means of a switch carrying a small current, or by push-button operation, when a start and stop push-button station is supplied. It is possible to arrange for starting and stopping the motor from any number of stations. The starters are as standard made for starting the motor against full load torque about fifteen per hour, but heavier ratings are made for all classes of service up to the heaviest rolling mill duty.

The starters consist of a number of the contactors as shown in Figs. 7 and 8. In the case of the type. These latter serve to cut out the starting resistance automatically step by step after the shunt contactor has closed. The resistances are either of the wire unit or grid type, depending on H.P. and voltage, and are self-

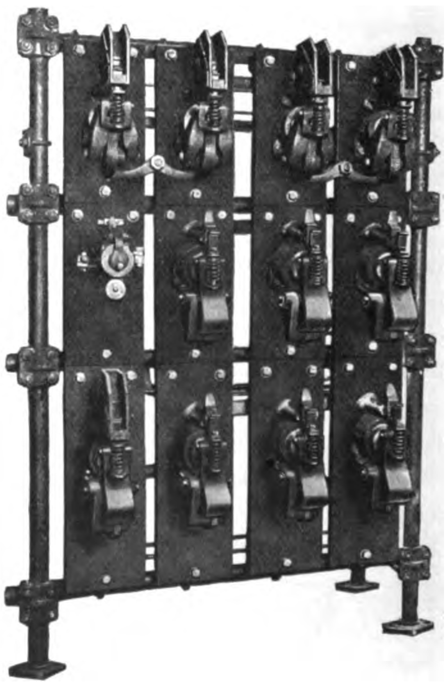


Fig. 6.

TYPICAL OF LARGE BRITISH WESTINGHOUSE DIRECT-CURRENT LOCK-OUT CONTACTOR STARTERS; WITH OVERLOAD TRIP.

contained on the smaller sizes, and are separate on the larger.

For certain classes of work the lock-out contactors are replaced by shunt-wound contactors throughout,

with series-wound relays which control the rate of acceleration.

Overload releases are not fitted with these automatic contactor starters, unless specially called for. The standard form of overload release is that fitted with the

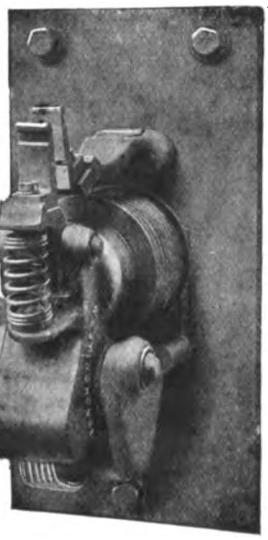


Fig. 7.
BRITISH WESTINGHOUSE SERIES CONTACTOR.

hand reset feature, which necessitates the operator going to the panel after the overload release has operated so giving an opportunity of inspection with a view of finding the cause of the overload. An electrically reset overload can be supplied, however, which can be reset by the operator from the push-button station.

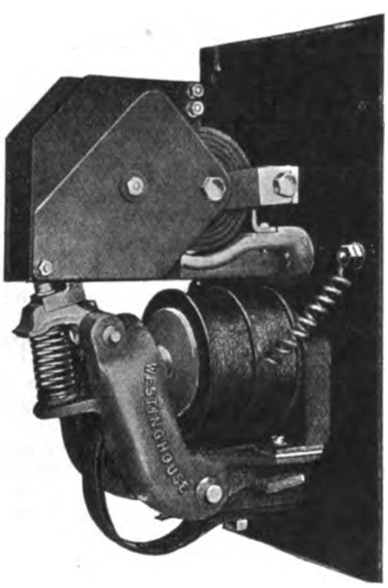


Fig. 8.
BRITISH WESTINGHOUSE SHUNT CONTACTOR; WITH BLOW-OUT.

When used in conjunction with a variable speed motor in which the range of speed is high, or when the motor is unable to start with the field rheostat in the high-speed position a field accelerating relay is provided. This relay serves to short circuit the field rheostat, until all the starting resistance has been cut out, and then automatically brings the motor up to the speed for which the rheostat is set by inserting the field resistance.

Covers are always provided for the smaller sizes, but the larger sizes are open type. If protection is required for these large starters it is deemed advisable to mount them in separate housings in order to facilitate inspection.

STEEL-CLAD MOTOR CONTROL PILLARS, TYPE P.

The British Westinghouse Company have recently introduced a steel-clad motor control pillar—type P—

Fig. 9.
BRITISH WESTINGHOUSE TYPE P CONTROL PILLAR, CONTAINING STARTER, FIELD REGULATOR, CONTACTOR CIRCUIT BREAKERS AND AMMETER.

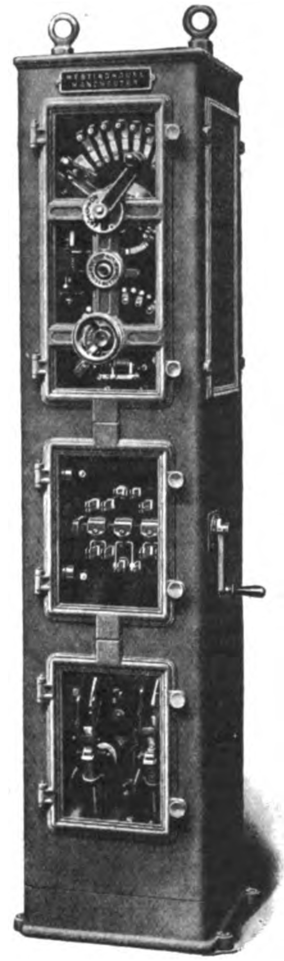


Fig. 10.
BRITISH WESTINGHOUSE SPECIAL TYPE P PANEL, CONTAINING MOTOR STARTER ELECTRICALLY INTERLOCKED WITH TWO SINGLE-POLE CONTACTORS, FIELD REGULATOR AND INTERLOCKED REVERSING SWITCH.

designed particularly to meet the specifications of various Government Departments, Foreign and Colonial Railway Companies, etc. The pillar is liberally rated and is constructed of gear of standardized design suitable for heavy service. The arrangement which has been adopted of enclosing all the control gear in a sheet-steel housing is already recognised as the most convenient method of combining the various items comprising a complete motor control equipment. Figs. 9 and 10

illustrate two typical standard control pillars arranged for floor mounting. In the case of the smaller sizes the panels can be supplied for wall-mounting.

The containing case consists of a cast-iron base which supports the frame on which the switch panels are mounted, the top is also of cast iron and the sides are enclosed in sheet steel, with hinged glazed doors in the front. The cable entries are through a large hole in the base casting, but alternatively the base can be drilled to receive conduit or gas pipe, or cable clamps for armouring can be fitted. The whole construction can be made dust and weatherproof, suitable for installation in the open, providing the apparatus is not likely to be subject to immersion. All internal wiring is complete, and the only connections to be made on site are those directly to the supply mains and motor, terminals for which are situated at the bottom of the pillar and on the front of the base, so that the connecting up can be effected quite easily.

The main switches have two breaks per pole, no current being carried through the hinge. They are quick break and of the knife pattern. The fuses are the porcelain handle type, and comply with the latest Home Office requirements. They are fixed on the front of the switch panels in accessible positions, so that they can be easily renewed.

Intead of a combination of hand-operated loose-handle circuit breaker and starting switch, the Company has adopted a combination of starting switch and two magnetically-operated switches, *i.e.*, contactor type circuit breakers interlocked with the starter. This arrangement provides all the features of a loose handle circuit breaker, with the advantage that only one operating handle is required, and all circuit making and breaking must be done on the contactors. A slow motion gear on the starter is, of course, unnecessary with this arrangement, as any attempt to cut out the starting resistance too quickly will at once open the circuit breakers. The fact that all current making and breaking must be done on the circuit breakers considerably lengthens the life of the contacts on the starting switch. The interlocking device is such that any backward movement of the starting switch will at once open the circuit breakers. Thus "pitting" and "burning" of the starter contacts is reduced to a minimum. The starter handle will only close the contactors when it is in the off position. The contactors are of very substantial construction, provided with renewable contacts, and a magnetic blow-out on both poles where all current breaking takes place.

The starters are of a special faceplate pattern of heavy construction, with renewable contacts on all sizes and special carbon arcing rollers where necessary. The no-volt coils are always connected independently of the machine field winding and the overload relays are therefore arranged to break the no-volt coil circuit. It will be noticed that the standard pillar, as a result of this arrangement, can be used for series, shunt or compound wound motors without alteration.

A slow-motion gear can be fitted to any starter, but this extra feature is only necessary where a double pole switch and fuses are used. It is of use, however, with the contactor and starter combination, as, being of the ratchet step-to-step pattern, it provides a means of ensuring that the operator shall only stop directly over each contact.

Where contactor type circuit breakers are fitted, a push-button emergency stop is provided to shut down the machine. This push button is in the operating coil circuit of the contactor switches, the main circuit being broken on the contactor switches. Additional push-button switches for stopping the machine from a distance can be provided if required.

Field regulators, when provided, can be arranged to give anything up to 1 : 4 speed range, and are always fitted with an electrical interlock which makes it impossible to start up the motor with a weakened field. This device necessitates the field regulator being reset after each start if the motor was running above normal speed when shut down. In cases where this procedure is objected to for any reason the company supplies a patent automatic field accelerating relay at a small extra cost. This ensures that the motor always starts up under full field, but automatically accelerates up to the speed at which it was running before the shut down, without any attention from the operator or alteration of the field regulator. This feature is particularly useful when it is desired to maintain the operating speed exactly.

The ammeters, voltmeters, etc., which are supplied are of the British Westinghouse 6-in. diameter moving iron dead-beat pattern with gravity control. They comply with the British Engineering Standards Committee specification for Grade 1 instruments. These instruments are of the pedestal type and are mounted on the top of the pillar casing. If moving coil instruments are wanted, they are also 6-in. dial, and similar in general appearance; they also comply with the Grade 1 instrument specification.

The combination of starter and electrically interlocked contactor switches, while isolating the motors, always leaves a certain amount of the apparatus inside the control pillar alive. To meet this difficulty, the Company provide a combination which includes in addition a double-pole isolating switch which makes everything inside the pillar "dead," with the exception of the line terminals and the line contacts of the isolating switch. These, however, are shrouded, and it is impossible for them to be touched either accidentally or otherwise.

Safety door interlocks are provided. In the case of the pillars containing switches, the doors are interlocked with the main switch, so that they cannot be opened except when the main switch is in the open circuit position and the latter cannot be moved while the doors are open. Pillars containing contactors are interlocked, so that the main contactors cannot be closed while the doors are open. The contactors open circuit at once should an attempt be made to open the doors.

CROMPTON & CO., LTD.

SLOW-SPEED CONTINUOUS-CURRENT GENERATORS.

Steam turbines for coupling direct to high-speed continuous-current generators have now been practically superseded by steam turbines arranged with reduction gearing, where the slow-speed shaft is direct-coupled to a continuous-current generator. There are, however, many mill engineers and others who still object to anything in the nature of medium or high-speed plant, and who are convinced that all prime movers and generating plant should be of the slow-speed type.

There is at the present time a considerable demand for a combination type of engine, where the generator is mounted direct on the engine crankshaft and driven positively through the armature hub casting and the engine flywheel. The engine is also arranged to drive other machinery or line shafting adjacent to the engine-room by means of belts or ropes, the more distant machines and shafting being driven by motors.

A typical view of one of these modern slow-speed generating sets is illustrated by Fig. 11.

The engine is of the well-known "Paxman Lentz" type, having tandem cylinders and a single crank, the rim of the flywheel being grooved for driving by ropes the adjacent mill shafting. The various auxiliaries, such as air and circulating pumps, erected below the engine floor, are also driven from the engine shaft.

The generator is of Messrs. Crompton & Co.'s latest design, embodying all modern improvements in construction, and is typical of some twenty similar machines

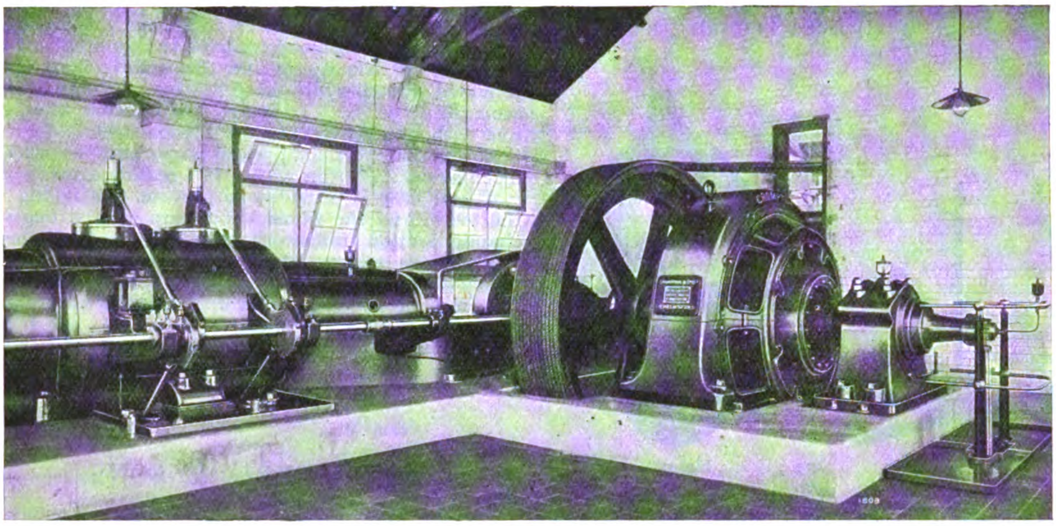


Fig 11.

supplied during the past few months. The machine is designed for running continuously at its full rated load day and night throughout the week, and is capable of withstanding heavy intermittent overloads with sparkless commutation and a fixed brush position at all loads up to the maximum overload.

A special feature of these machines is the impregnation of the windings. The interpoles and field coils are solidly impregnated with waterproof compound at a pressure of 50 to 60 lbs. per square inch. They are first dried in a vacuum and the impregnation process is carried out without breaking the vacuum. The armature coils are similarly treated with special insulating and waterproof varnish. As a result, the coils are quite impervious to moisture and fumes of any description, thereby increasing considerably the life of the machine. The brush gear is supported from the magnet frame by suitable castings of rigid construction, without in any way interfering with the accessibility of the commutator.

It must be acknowledged that provided sufficient floor space is available and local conditions suitable, a slow-speed generating set of medium size, with its low steam consumption, minimum cost of renewals, less wear and tear of brushes and of the moving parts, gives highly satisfactory results.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.

Extracted particulars and illustrations from the new Ediswan Fan Catalogue should prove of general interest at the moment. As the readers of this Journal already know the many benefits of ELECTRIC FANS FOR VENTILATION, we will merely describe the four fans illustrated, which are the most popular patterns for their respective uses.

Fig. 12 illustrates the Ediswan Convertible Table Bracket Fan (continuous current) which is the noted model of the Company, and is a silent-running fan, therefore highly recommended for hospitals, convalescent homes, etc., as well as for ordinary home comforts. It is made in two diameters of blade, 12 and 16 inch, with current consumption of 40 and 75 watts. Speed 1.000/1,100 r.p.m.

Fig. 13 is of an excellent Fan specially designed for use on steamships, trains, etc., so constructed and insulated as to withstand the action of sea air and hot climates. The essential feature of this fan is its special COMBINED supporting device and connection, by which means the fan is easily detachable. One or more supports can be fitted in each cabin or saloon, so that the passenger can fix the fan to his own requirements, whilst by means of the swivel and trunnion movement the fan can be set to blow in any desired direction. (Particulars on application.)

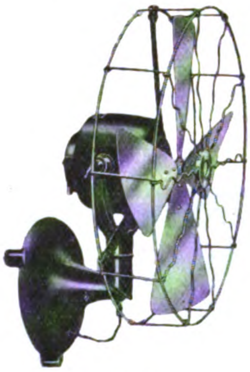


Fig. 12.

Fig. 13.

Fig. 14 shows the popular "Ediswan" Ceiling Fan, which is specially suitable for large halls, cinema theatres, clubs, institutions, etc. Capable of energeti-

cally moving the air within a large radius without noise. Fitted with four 54-in. blades, 140 watts, 100 to 210 volts, speed 160/200 r.p.m.

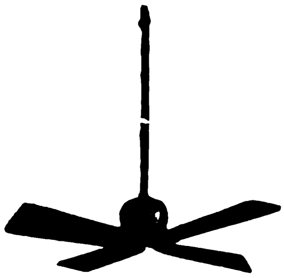


Fig. 14.

Fig 15.

Fig. 15 illustrates an Ediswan Porthole Silent Running Fan. Fitted with four 12-in. or 16-in. blades with current consumption of from 40 to 75 watts.

ELECTROMOTORS, LIMITED.

The electric driving of wood-working machinery always presents a variety of problem, and we illustrate under Fig. 16 a special form of gear designed for the electrification of an existing vertical log saw frame.

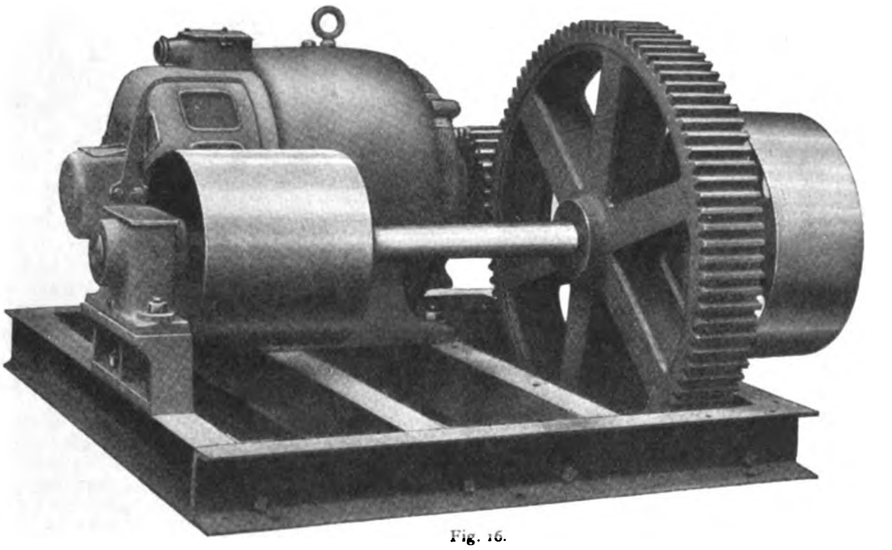


Fig. 16.

The machine is designed to drive on to the existing power and feed pulleys, and the whole apparatus is fixed underground.

The illustration in question shows a 40 H.P. compound wound 500-volt. interpole motor designed to run at speeds varying from 450/900 r.p.m. by shunt control.

The motor is of the enclosed ventilated type with close gauze grids to keep out sawdust; the terminal box is of the enclosed pattern with the nose screwed to take the cable tubes; large bearings having two oil rings to each bearing are fitted, and swing doors on loose pins so that ample access to the machine is possible.

The motor is designed to drive the countershaft at a speed of 118/235 r.p.m. and this countershaft is also provided with ring lubricated bearings. These bearings are built up on " A " frames so that the spur wheel runs free without cutting into the foundations.

The pinion is of compressed paper and the wheel of machine-cut cast iron with " H " section arms.

A gear case is provided to prevent bits falling into the teeth, and the whole is built up on a strong steel channel section framework securely bolted together.

The large pulley drives direct on to the flywheel pulley of the saw frame, while straight and crossed belts run from the smaller pulley on to the feed motion, so as to feed in both directions.

The illustration is typical only and other sizes are available.

A. P. LUNDBERG & SONS.

Said the turbo to the tumbler,
" You're a little chap, it's true,
And on my most extensive back
I could take a lot of you."

Said the tumbler to the turbo,
" If numbers count at all,
My fellows congregated
Would make you look quite small."

TUMBLER-SWITCH CONTROLS FOR GLOW-LAMP CIRCUITS.

But a few years ago it was usual to find in a first-class electric-light installation that while money was lavished on expensive fittings, little or no attention had been given to the illuminating effect.

Nowadays, though things are much improved in this respect, the average installation still lacks convenience as regards the methods of controlling the lights at the switches. Thus one might almost compare such an installation to a beautiful-looking piece of machinery which worked badly.

Good " switching " puts the finishing touch to an installation; but as the facilities available are comparatively novel, especially as nothing like them has ever been (or could ever be) secured with gas-pipes or gas-taps, the principles require a little careful examination before they can be fully understood and appreciated.

There are many people concerned with electric lighting to whom the ordinary circuit diagram or connection diagram is somewhat bewildering, especially when they try to explain it to a non-technical customer. An entirely new kind of diagram, which we call a control diagram, has therefore been devised for the chief purpose of overcoming the above-mentioned drawback. Its advantages, as will be seen by the following illustrations, is that there is no need to trouble about the inside of the switch or the number of lamps. What the diagrams

do show is the type of switch (or switches); the lighting effects it (or they) produce; and the number of wires to and from them.

progressive consulting engineers, architects and contractors, the fact that electric light may be turned "on" or "off" at any one of two or more switches,

Fig. 17. SINGLE-WAY CONTROL.

In the diagram in Fig. 17, the light *L*, due to one or more lamps, can only be turned on or off at one switch. This is the simplest and least flexible of electric-switch controls, and is the only one in use in most ordinary installations. It represents the extent of some people's knowledge of electric-light switching, and yet is merely the very beginning of the subject.

or on at one and off at another, is such an unusual idea with ordinary people that they take quite a long time to get used to it. One reason for this is that the advantages of "multipoint control" of light have never been possible with gas. Anyone who fails to comprehend the everyday use of these unique features of the electric switch-and-wire system may be compared

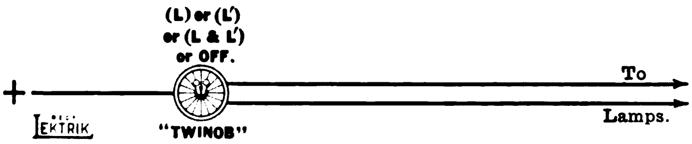


Fig. 18. "TWINOB" CONTROL.

The Fig. 18 control gives "either" or "both" circuits. It thus affords three degrees of light if *L* and *L*¹ are different numbers of lamps or lamps of different candle-power.

The switch has two knobs, and consists, in fact, of two ordinary or single-way switch movements on one base.

with an (imaginary) architect who never puts more than one window in a room, or who invariably makes all his windows of the same size.

With two-way control (Fig. 19) the light *L* (due to one ore more lamps) can be turned "on" or "off" at either switch, or "on" at one and "off" at the other.

Those who find the above matter of interest should

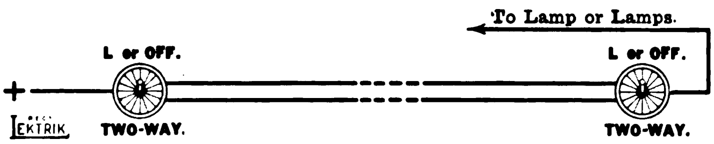


Fig. 19. TWO-WAY CONTROL.

In the thousands of cases where it is usual to put two ordinary switches in a room, the substitution of a "Twinob" switch makes for neatness, compactness and less cost for labour, material and switches.

Although quite well-known and appreciated by

write to us for a copy of our gratis publication "*Tumbler-Switch Controls.*" which forms a sort of introduction to the matter as fully dealt with in our "Booklet" advertised on another page.

SI vous n'avez pas encore acheté vos machines électriques, vos machines à vapeur et vos accessoires chez des fabricants anglais, voici un bon moment pour commencer des relations avec les membres de l'Association des Fabricants Anglais de machines électriques et autres similaires (B.E.A.M.A.). Ils fabriquent toutes les marchandises de ce genre, toutes de la plus haute qualité. Ils produisent tous ces articles au plus bas prix relativement à la qualité. Les marchandises anglaises sont toujours les meilleures parce qu'elles sont dignes de confiance et un bon choix est sûr de donner satisfaction.

CLASSIFIED DIRECTORY OF MANUFACTURES

MANUFACTURES OF MEMBERS. PRODUCTIONS DES ASSOCIES. PRODUCCIONES DE LOS SOCIOS
ПРОИЗВОДСТВА УЧАСТВУЮЩИХЪ ФИРМЪ.

ACCESSORIES for Power, Lighting, Bells and Signalling.
ACCESSOIRES pour Force Motrice, Eclairage, Sonneries et Signaux.
ACCESORIOS para Fuerza Motriz, Alumbrado, Campanillas y Señales.
ПРИНАДЛЕЖНОСТИ для Двигателей, Освѣщенія, Звонковъ и Сигналовъ.

Bells (for bell wires, see under " Wires ").
Sonneries (pour fils de sonneries, voir " Fils ").
Campanillas (para alambres de campanillas, véase " Alambres ").
Звонки (звонк. провода, см. ,,Провода").

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SANDYCROFT LTD.
SIEMENS BROS. & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Casing and Capping.
Moulures pour Fils.
Cajetines para Alambres.
Рейки для Проводовъ.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Roses.
Rosaces de Plafond.
Rosetones de Techo.
Потолочныя Розетки.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Cut-outs.
Coupe-Circuits.
Cortacircuitos.
Предохранители.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
IGRANIC ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Indicators.
Indicateurs.
Indicadores.
Индикаторы.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
NALDER BROS. & THOMPSON, LTD.
REASON MANUFACTURING CO., LTD.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Lampholders.
Douilles.
Portalámparas.
Патроны.

BERRY, SKINNER & CO.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Plugs and Sockets.
Fiches et Prises de Courant.
Llaves y Cajas de Contacto.
Контачныя Штепселя и Коробки.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Pushes.

Boutons de Poussoirs.

Botones de Llamada.

Звонковыя Кнопки.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Tumbler Switches.

Interrupteurs à Boule.

Llaves de Concha.

Выключатели съ опрок. головкой.

BERRY, SKINNER & CO.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Wood Blocks.

Tampons en Bois.

Tacos de Madera.

Деревянные Закрѣпы.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Accessories for accumulators, arc lamps, batteries, telephones, etc., see under those headings.

Accessoires pour accumulateurs, lampes à arc, batteries, téléphones, etc., voir ces mots.

Accesorios para acumuladores, lámparas de arco, baterías, teléfonos, etc., véanse estas palabras.

Принадлежности для аккумуляторовъ, дуговыхъ лампъ, батарей, телефоновъ, и пр., см. эти слова.

ACCUMULATORS.

ACCUMULATEURS.

ACUMULADORES.

АККУМУЛЯТОРЫ.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
D.P. BATTERY CO., LTD.
TUDOR ACCUMULATOR CO., LTD.
PRITCHETTS & GOLD AND ELECTRIC POWER STORAGE CO., LTD.

Accumulator Switches and Switchboards, see under "Switchgear."

Commutateurs et Tableaux de Distribution pour Accumulateurs, voir "Appareils de Distribution."

Conmutadores y Cuadros de Distribución para Acumuladores, véase "Aparatos de Distribución."

Аккумуляторные Коммутаторы и Распредѣлительныя доски, см. „Распредѣлительныя Устройства".

ACCUMULATORS (Heat, Regenerative).

ACCUMULATEURS de Chaleur Régénérative.

ACUMULADORES de Calor Regenerativo.

АККУМУЛЯТОРЫ Регенеративаго Тепла.

RICHARDSONS, WESTGARTH & CO., LTD.

AIR COMPRESSORS, see "Compressors."

COMPRESSEURS d'AIR, voir "Compresseurs."

COMPRESORES de AIRE, véase "Compresores."

ВОЗДУШНЫЕ КОМПРЕССОРЫ, см. „Компрессоры".

AIR FILTERS.

Filtres d'Air.

Filtros de Aire.

Воздушные Фильтры.

PREMIER COOLER & ENGINEERING CO., LTD.

ALTERNATORS, see "Generators."

ALTERNATEURS, voir "Génératrices."

ALTERNADORES, véase "Generadores."

АЛЬТЕРНАТОРЫ, см. „Генераторы".

ARC LAMPS and Accessories.

LAMPES à ARC et Accessoires.

LAMPARAS de ARCO y Accesorios.

ДУГОВЫЯ ЛАМПЫ или ФОНАРИ и Принадлежности.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Standards.

Poteaux de Lampes à Arc.

Columnas de Lámparas de Arco.

Столбы для Дуговыхъ Лампъ.

BERRY, SKINNER & CO.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Winches.

Treuils de Levage pour Lampes à Arc.

Tornos de Elevación para Lámparas de Arco.

Лебедки для Дуговыхъ Лампъ.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Carbons, see under " Carbons."
Crayons de Lampes à Arc, voir " Crayons."
Carbones para Lámparas de Arco, véase " Carbones."
Угли для Дуговыхъ Лампъ, см. ,,Угли".

Arc Lamp Globes, see under " Glassware."
Globes de Lampes à Arc, voir " Verreries."
Globos de Lámpara de Arco, véase " Cristaleria."
Шары для Дуговыхъ Лампъ, см. ,,Стеклянная Посуда".

AUTOMOBILE SWITCHBOARDS.
TABLEAUX de DISTRIBUTION pour AUTOMOBILES.
CUADROS de DISTRIBUCION para AUTOMOVILES.
КОММУТАЦІОННІЯ ДОСКИ для АВТОМОБИЛЕЙ.

LUNDBERG, A. P., & SONS.

BATTERIES, Primary and Accessories.
BATTERIES, Primaires et Accessoires.
BATERIAS, Primarias y Accesorios.
БАТАРЕИ Первичныя и Принадлежности.

Dry Cells.
Piles Sèches.
Pilas Secas.
Сухie Элементы.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.
SUN ELECTRICAL CO., LTD.

Ignition Cells.
Piles d'Allumage.
Pilas de encender.
Зажигательныя Батареи.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Wet Cells (Leclanché, etc.).
Piles Hydroélectriques (Leclanché, etc.).
Pilas Hidroeléctricas (Leclanché, etc.).
Мокрые Элементы (Лекланше и др.).

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

BELLS, see under " Accessories."
SONNERIES, voir " Accessoires."
CAMPANILLAS, véase " Accesorios."
ЗВОНКИ, см. ,,Принадлежности".

BLOWERS, see COMPRESSORS.
SOUFFLERIES, voir **COMPRESSEURS.**
SOPLADORES, véase **COMPRESORES.**
ВОЗДУХОДУВКИ, см. **КОМПРЕССОРЫ.**

BOILERS and Boiler Equipments.
CHAUDIERES et Accessoires de Chaudières.
CALDERAS y Accesorios de Calderas.
КОТЛЫ и Котельная Арматура.

CLARKE, CHAPMAN & CO., LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.

BOOSTERS, see under " Generators."
SURVOLTEURS, voir " Génératrices."
ELEVADORES de TENSION, véase " Generadores."
ПОВЫСИТЕЛИ НАПРЯЖЕНІЯ (БУСТЕРЫ), см. ,,Генераторы".

BRAKES (Magnetic).
FREINS Magnétiques.
FRENOS Magnéticos.
Магнитные ТОРМАЗА.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.

BRUSHES, Carbon, for Electrical Machinery.
BALAIS en Carbone pour Appareils Electriques.
ESCOBILLAS de Carbón para Aparatos Eléctricos.
УГОЛЬНЫЯ ЩЕТКИ для Электрическихъ Машинъ.

MORGAN, CRUCIBLE CO., LTD.

CABLES (see also " Wires ") and Cable Accessories.
CÂBLES (voir aussi " Fils ") et Accessoires de Câbles.
CABLES (véase también " Alambres ") y Accesorios de Cables.
КАБЕЛИ (см. также ,,Провода") и Принадлежности.

Paper Insulated Cables.
Câbles Isolés au Papier.
Cables Aislados con Papel.
Кабели съ Бумажной Изоляціей.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Rubber Insulated Cables.
Câbles Isolés au Caoutchouc.
Cables Aislados con Caucho.
Кабели съ Резиновой Изоляціей.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Submarine Cables.
Câbles Sous-Marins.
Cables Submarinos.
Поводные Кабели.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Telephone Cables.
Câbles Téléphoniques.
Cables Telefónicos.
Телефонные Кабели.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Junction Boxes.
Boîtes de Dérivation.
Cajas de Derivación.
Отвѣтвительныя Коробки.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
LUCY, W., & CO.
SIEMENS BROS. & CO., LTD.

Expansion Joints.
Joints Extensibles.
Empalmes Extensibles.
Растяжимыя Соединенія.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
REYROLLE, A. & CO., LTD.
SIEMENS BROS. & CO., LTD.

CARBONS.
CHARBONS.
CARBONES.
УГЛИ.

For Arc Lamps.
Pour Lampes à Arc.
Para Lámparas de Arco.
Для Дуговыхъ Лампъ.
CROMPTON & CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Carbon Brushes, see under " Brushes."
Balais en Carbone, voir " Balais."
Escobillas de Carbón, véase " Escobillas."
Угольныя Щетки, см. ,,Щетки".

Carbon Crucibles, see under " Crucibles."
Creussets en Carbone, voir " Creusets."
Crisoles de Carbón, véase " Crisoles."
Тигли Угольные, см. ,,Тигли".

CEILING ROSES, see under " Accessories."
ROSACES DE PLAFOND, voir " Accessoires."
ROSETONES DE TECHO, véase " Accesorios."
ПОТОЛОЧНЫЯ РОЗЕТКИ, см. ,,Принадлежности".

CELLS, see " Accumulators " and " Batteries."
PILES, voir " Accumulateurs " et " Batteries."
PILAS, véase " Acumuladores " y " Baterías."
ЭЛЕМЕНТЫ, см. ,,Аккумуляторы" и ,,Батареи".

CLOCKS, Electrically driven.
HORLOGES Electriques.
RELOJES Eléctricos.
ЧАСЫ Электрическіе.
ARON ELECTRICITY METER, LTD.
VENNER & CO.

COLLIERIES, Equipment of, see " Mines."
HOUILLERES, Equipements de, voir " Mines."
HULLERAS, Equipos de, véase " Minas."
КАМЕННОУГОЛЬНЫЯ КОПИ, ихъ оборудованіе, см. ,,Рудники".

COMPRESSORS AND BLOWERS.
COMPRESSEURS et SOUFFLERIES.
COMPRESORES y SOPLADORES.
КОМПРЕССОРЫ и ВОЗДУХОДУВКИ.
ALLEN, W. H., SON & CO., LTD.
ALLEY & MACLELLAN, LTD.
BELLISS & MORCOM, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
BROWETT, LINDLEY & CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
PARSONS, C. A., & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

CONDENSERS, ELECTRICAL.
CONDENSATEURS ELECTRIQUES.
CONDENSADORES ELECTRICOS.
КОНДЕНСАТОРЫ ЭЛЕКТРИЧЕСКІЕ.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
GENERAL ELECTRIC CO., LTD.
HICK, HARGREAVES & CO., LTD.
JOHNSON & PHILLIPS, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
SIEMENS BROS. & CO., LTD.

CONDENSERS, STEAM.
CONDENSEURS de VAPEUR.
CONDENSADORES de VAPOR.
КОНДЕНСАТОРЫ ПАРОВЫЕ.

ALLEN, W. H., SON & CO., LTD.
ASHWORTH & PARKER.
BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
HICK, HARGREAVES & CO., LTD.
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

CONDUITS and Conduit Fittings.
TUBES ISOLANTS et Accessoires pour Tubes.
TUBOS AISLADORES y Accesorios para Tubos.
ИЗОЛЯЦІОННЫЯ ТРУБКИ и ихъ Принадлежности.

CREDENDA CONDUITS CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

CONTROL GEAR.
APPAREILS CONTROLEURS.
APARATOS DE COMPROBACION.
КОНТРОЛЬНЫЕ АППАРАТЫ.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTRIC CONTROL LTD. (Automatic Control Gear only).
ELECTRICAL APPARATUS CO., LTD.
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REYROLLE & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
WEST, ALLEN, & CO., LTD.
WHIPP & BOURNE.

Controllers for Crane Motors.
Contrôleurs pour Moteurs de Grues.
Controleres para Motores de Grúas.
Контролеры для Крановыхъ Моторовъ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELLISON, GEORGE.
IGRANIC ELECTRIC CO., LTD.
WEST, ALLEN, & CO., LTD.

Controllers for Traction Work.
Contrôleurs pour Moteurs de Tramway.
Controleres para Motores de Tranvia.
Контролеры для Трамвайныхъ Моторовъ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELLISON, GEORGE.
SIEMENS BROS. DYNAMO WORKS, LTD.
WEST, ALLEN, & CO., LTD

Motor Starters and Panels.
Démarreurs et Tableaux de Démarrage pour Moteurs.
Aparatos y Cuadros de Arranque para Motores.
Пусковые Аппараты и Доски для Моторовъ.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
MORRIS & LISTER, LTD.
REYROLLE, A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Rheostats.
Rhéostats.
Reostatos.
Реостаты.

BERRY, SKINNER & CO.,
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLIOTT BROTHERS.
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
NALDER BROS. & THOMPSON, LTD.
PAUL, ROBERT W.
REYROLLE, A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WEST, ALLEN, & CO., LTD.
WHIPP & BOURNE.

CONVERTERS (Motor).
TRANSFORMATEURS en CASCADE.
TRANSFORMADORES en CASCADA.
КАСКАДНЫЕ КОНВЕРТЕРЫ.

(PEEBLES—LA COUR PATENTS).
PEEBLES, BRUCE, & CO., LTD.

CONVERTERS, ROTARY.
COMMUTATRICES.
CONVERTIDORES ROTATORIOS.
ВРАЩАЮЩІЕСЯ КОНВЕРТЕРЫ (ПРЕОБРАЗОВАТЕЛИ).

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.
WRIGHT & WOOD, LTD.

Converters, Static, see " Transformers."
Transformateurs Statiques, voir " Transformateurs."
Transformadores Estáticos, véase " Transformadores."
Статическіе Преобразователи, см. ,,Трансформаторы".

COOKING APPLIANCES ELECTRICAL, see " Heating and Cooking."
USTENSILES ELECTRIQUES de CUISINE, voir " Chauffage et Cuisine."
UTENSILIOS ELECTRICOS de COCINA, véase " Caldeo y Cocina."
ЭЛЕКТРИЧЕСКІЕ КУХОННЫЕ ПРИБОРЫ, см. ,,Отопленіе и Кухонные Приборы".

CRANE EQUIPMENTS, see also " Control Gear," " Motors," etc.
EQUIPEMENT DE GRUES, voir aussi " Appareils Contrôleurs," " Moteurs," etc.
EQUIPOS DE GRUAS, véase también " Aparatos de Comprobación," " Motores," etc.
СНАРЯЖЕНІЕ для КРАНОВЪ, см. также ,,Контрольные Аппараты", ,,Моторы" и пр.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
ELLISON, GEORGE.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WEST, ALLEN, & CO., LTD.

CRUCIBLES, Electric.
CREUSETS Electriques.
CRISOLES Eléctricos.
ТИГЛИ Эликтрическіе.

MORGAN CRUCIBLE CO., LTD.

CUT-OUTS, see " Accessories."
COUPE-CIRCUITS, voir " Accessoires."
CORTACIRCUITOS, véase " Accesorios."
ПРЕДОХРАНИТЕЛИ, см. ,,Принадлежности".

DISTRIBUTION BOARDS, see also "Switchgear."
TABLEAUX DE DISTRIBUTION, voir aussi "Appareils de Distribution."
CUADROS DE DISTRIBUCION, véase también "Aparatos de Distribución."
РАСПРЕДѢЛИТЕЛЬНЫЯ ДОСКИ, см. также „Распредѣлительныя Устройства".

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
SWITCHGEAR & COWANS, LTD.

DOMESTIC APPLIANCES, see also "Heating and Cooking," "Fans," etc.
APPAREILS DOMESTIQUES, voir aussi "Chauffage et Cuisine," "Ventilateurs," etc.
APARATOS DOMESTICOS, véase también "Caldeo y Cocina," "Ventiladores," etc.
ДОМОВЫЯ УСТАНОВКИ, см. также „Отопленie и Освѣщенie", „Вентиляторы" и пр.

BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
SUN ELECTRICAL CO., LTD.

Vacuum Cleaners.
Nettoyeuses au Vide.
Limpiadores de Vacío.
Пылесосы.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.

DRILLS, Electrically driven.
FOREUSES Electriques.
PERFORADORES Eléctricos.
Электрическіе СВЕРЛИЛЬНЫЕ СТАНКИ.

BOOTHROYD, H. T., LTD.
REES ROTURBO MANUFACTURING CO., LTD.

Portable Drilling Machines.
Foreuses Portatives.
Perforadores Portátiles.
Переносные Сверлильные Станки.

BOOTHROYD, H. T., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
REES ROTURBO MANUFACTURING CO., LTD.

DYNAMOS, see "Generators."
DYNAMOS, voir "Génératrices."
DINAMOS, véase "Generadores."
ДИНАМО, см. „Генераторы".

ENGINES, see "Prime Movers."
MACHINES, voir "Machines Motrices."
MAQUINAS, véase "Máquinas Motoras."
ДВИГАТЕЛИ, см. это слово.

FANS.
VENTILATEURS.
VENTILADORES.
ВЕНТИЛЯТОРЫ.

Bracket Fans.
Ventilateurs à Console.
Ventiladores de Consola.
Консольные Вентиляторы.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Fans.
Ventilateurs de Plafond.
Ventiladores de Techo.
Потолочные Вентиляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO.
SUN ELECTRICAL CO., LTD.

Table Fans.
Ventilateurs de Table.
Ventiladores de Mesa.
Настольные Вентиляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.

PARSONS, C. A., & CO.
SUN ELECTRICAL CO., LTD.

Ventilating Fans.
Ventilateurs Extracteurs.
Ventiladores Extractores.
Вытяжные Вентиляторы.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
HOWDEN, JAMES, & CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

FITTINGS for Electric Light.
ACCESSOIRES pour Lumière Electrique.
ACCESORIOS para Luz Eléctrica.
ПРИНАДЛЕЖНОСТИ для Электрическаго Свѣта.

Brackets.
Appliques.
Brazos.
Кронштейны.

BRITISH THOMSON-HOUSTON CO., LTD.
CREDENDA CONDUITS CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Fittings.
Accessoires de Plafond.
Accesorios de Techo.
Потолочныя Гарнитуры.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Counterweights.
Contrepoids.
Contrapesos.
Противовѣсы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Electroliers.
Lustres.
Arañas.
Люстры.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Fancy Shades.
Abat-Jour Artistiques.
Pantallas Artisticas.
Декоративные Абажуры.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Hand Lamps.
Lampes à Main.
Lámparas de Mano.
Ручныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Lanterns.
Lanternes.
Linternas.
Фонари.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Pendants.
Lampes à Suspension.
Lámparas de Suspensión.
Подвѣсныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Reflectors.
Reflecteurs.
Reflectores.
Рефлекторы.

BRITISH THOMSON-HOUSTON CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PARSONS, C. A., & CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Standard Lamps.
Lampes Portatives.
Lámparas Portátiles.
Переносныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.

SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Street Fittings.

Matériel pour Eclairage Public.

Material para Alumbrado Público.

Матеріалъ для Уличнаго Освѣщенія.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Watertight Fittings for Mines, Dockyards, Shipwork, etc.

Accessoires Hermétiques pour Mines, Chantiers de Construction Navale, Navires, etc.

Accesorios Erméticos para Minas, Astilleros Buques, etc.

Водонепроницаемыя Устройства для Рудниковъ, Верфей, Судовъ и пр.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Carbons for Electric Furnaces, see " Carbons."

Electrodes pour Fours Electriques, voir " Crayons."

Electrodes para Hornos Eléctricos, véase " Carbones."

Электроды для Электрическихъ Печей, см. „Угли".

FUSES.

FUSIBLES.

FUSIBLES.

ЛЕГКО-ПЛАВКІЯ ВСТАВКИ.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC CONTROL, LTD. (High Tension).
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
LUCY, W., & CO., LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REASON MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

GENERATORS, A.C. and D.C.

GENERATRICES, à C.C. et à C.A.

GENERADORES, de C.C. y C.A.

ГЕНЕРАТОРЫ Пост. и Перем. Тока.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PARSONS, C. A., & CO., LTD
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Boosters.

Survolteurs.

Elevadores de Tensión.

Новысители Напряженія (Бустеры).

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Generators for Electro-Plating.

Génératrices pour Galvanoplastie.

Generadores para Galvanoplastia.

Генераторы для Гальванопластики.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.

MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Motor-Generators.
Moteurs-Générateurs.
Motores-Generadores.
Двигатели-Генераторы.

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD
SIEMENS BROS. DYNAMO WORKS, LTD.
SANDYCROFT, LTD.
VICKERS, LTD.

Turbo-Alternators.
Turbo-Alternateurs.
Turbo-Alternadores.
Турбо-Альтернаторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Continuous Current Turbo-Generators.
Turbo-Génératrices à Courant Continu.
Turbo-Dinamos de Corriente Continua.
Турбо-Генераторы Пост. Тока.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
MATHER & PLATT, LTD.
GREENWOOD & BATLEY, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAWO WORKS, LTD.
VICKERS, LTD.

GLASSWARE.
VERRERIES.
CRISTALERIA.
СТЕКЛЯННАЯ ПОСУДА.

Arc Lamp Globes.
Globes de Lampes á Arc.
Globos de Arco.
Шары для Дуговыхъ Лампъ.

Glass Shades.
Abat-Jour en Verre.
Pantallas de Vidrio.
Стеклянные Абажуры.

Holophane Ware.
Verreries Holophanes.
Cristaleria Holófana.
Голофанная Посуда.

MOST MEMBERS OF THE B.E.A.M.A. SELL THESE WARES.

HEATING AND COOKING APPLIANCES, Electrical.
APPAREILS Electriques de **CHAUFFAGE** et de **CUISINE.**
APARATOS Eléctricos de **CLADEO** y de **COCINA.**
Электрическіе **НАГРѢВАТЕЛЬНЫЕ и КУХОННЫЕ ПРИБОРЫ.**

CREDENDA CONDUITS CO., LTD.
BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

Radiators, see this word under main headings.
Radiateurs, voir ce mot.
Radiadores, véase esta palabra.
Радіаторы, см. это слово.

INCANDESCENT LAMPS, see " Lamps."
LAMPES à INCANDESCENCE, voir " Lampes."
LAMPARAS de INCANDESCENCIA, véase " Lámparas."
ЛАМПЫ НАКАЛИВАНІЯ, см. ,,Лампы,,.

INDUCTION COILS, see " Medical Electro-Appliances " and " Wireless Telegraphy Appliances."
BOBINES d'INDUCTION, voir " Appareils Electro-Médicaux " et " Appareils de Télégraphie sans Fil."
CARRETES de INDUCCION, véase " Aparatos Eléctro-Medicales " y " Aparatos de Telegrafía sin Alambres."
ИНДУКЦІОННЫЯ КАТУШКИ, см. ,,Электро-Медицинскіе Аппараты" и ,,Радіо-Телеграфные Аппараты".

INSTRUMENTS, see also " Testing Sets."
INSTRUMENTS, voir aussi " Appareils de Laboratoire."
INSTRUMENTOS, véase también " Aparatos de Laboratorio."
ИНСТРУМЕНТЫ, см. также ,,Приборы для Испытанія".

Indicating Instruments (Ammeters, Voltmeters, Wattmeters, Phasemeters, Frequency Indicators, etc.).
Instruments de Mesure (Ampèremètres, Voltmètres, Wattmètres, Phasemètres, Fréquencemètres, etc.).
Instrumentos de Medida (Amperómetros, Voltímetros, Vatímetros, Fasómetros, Frecuencímetros, etc.).

Контрольные Аппараты (Амперметры, Вольтметры, Ваттметры, Фазометры, Частометры и др.).

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EGDCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. & CO., LTD.

Instrument Transformers.
Transformateurs de Mesure.
Transformadores de Medida.
Измѣрительные Трансформаторы.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SWITCHGEAR & COWANS, LTD.

Recording Instruments.
Instruments Enregistreurs.
Instrumentos Registradores.
Самопишущіе Приборы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.

Instruments, Integrating, see "Meters."
Compteurs Totalisateurs, voir "Compteurs."
Contadores Integradores, véase "Contadores."
Счетчики-Интеграторы, см. ,,Счетчики".

INSULATORS.
ISOLATEURS.
AISLADORES.
ИЗОЛЯТОРЫ.

Porcelain Insulators.
Isolateurs en Porcelaine.
Aisladores de Porcelana.
Фарфоровые Изоляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
IGRANIC ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Suspension Insulators.
Isolateurs de Suspension.
Aisladores ed Suspensión.
Подвѣсные Изоляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
SIEMENS BROS. & CO., LTD.

Tramway Insulators for Overhead Lines.
Isolateurs de Tramway pour Lignes Aériennes.
Aisladores de Tranvía para Líneas Aéreas.
Изоляторы для Трамвайныхъ Воздушныхъ Линій.

BRITISH INSULATED & HELSBY CABLES, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.

INSULATING MATERIAL.
MATIERES ISOLANTES.
MATERIALES AISLANTES.
ИЗОЛЯЦІОННЫЕ МАТЕРІАЛЫ.

Press Spahn and other Materials.
Cartons Comprimés et autres Matières.
Cartones Comprimidos y otros Materiales.
Прессованные Картоны и др. Матеріалы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
DAY, ST. JOHN (PATENTS), LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PIRELLI, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

JUNCTION BOXES, see "Cables" and "Conduits."
BOITES de DERIVATION, voir "Cables" et "Tubes Isolants."
CAJAS de DERIVACION, véase "Cables" y "Tubos Aisladores."
ОТВѢТВИТЕЛЬНЫЯ КОРОБКИ, см. „Кабели" и „Изолнц. Трубки".

LAMPS, see also "Arc Lamps."
LAMPES, voir aussi "Lampes à Arc."
LAMPARAS, véase también "Lámparas de Arco."
ЛАМПЫ, см. также „Дуговыя Лампы".

Incandescent Lamps (Carbon Filament, Metallic Filament and Drawn Wire Lamps).
Lampes à Incandescence (á Filament en Carbone, á Filament Métallique et à Fil Etiré).
Lámparas de Incandescencia (con Filamento de Carbón, Filamento metálico, y con Alambre Estirado).
Лампы Накаливанія (съ Угольной Нитью, Металлической Нитью и съ Тянутой Проволокой).

BRITISH THOMSON-HOUSTON CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
OSRAM-ROBERTSON LAMP WORKS, LTD.
SIEMENS BROS. & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

LAMPHOLDERS, see "Accessories."
DOUILLES, voir "Accessoires."
PORTALAMPARAS, véase "Accesorios."
ПАТРОНЫ, см. „Принадлежности".

LANTERNS, see "Fittings."
LANTERNES, voir "Garnitures."
LINTERNAS, véase "Guarniciones."
ФОНАРИ, см. „Гарнируры".

LIFT MOTORS, see "Motors."
MOTEURS d'ASCENSEURS, voir "Moteurs."
MOTORES PARA ASCENSORES, véase "Motores."
ПОДЪЕМНЫЕ МОТОРЫ, см. „Моторы".

LIGHTNING ARRESTERS.
PARAFOUDRES.
PARARRAYOS.
ГРОМООТВОДЫ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EVERETT, EDGCUMBE & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.

MAGNETOS.
MAGNÉTOS.
MAGNETOS.
МАГНЕТА.

BRITISH THOMSON-HOUSTON CO., LTD.

MAGNETS, LIFTING.
ELECTRO-AIMANTS.
ELECTRO-IMANES.
ЭЛЕКТРО-МАГНИТЫ.

ECKSTEIN, HEAP & CO., LTD.
ELECTRIC CONTROL, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
MORRIS & LISTER, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.

MAGNETS, PERMANENT.
AIMANTS PERMANENTS.
IMANES PERMANENTES.
ПОСТОЯННЫЕ МАГНИТЫ.

NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.

MEDICAL, ELECTRO-APPLIANCES.
APPAREILS ELECTRO-MEDICAUX.
APARATOS ELECTRO-MEDICALES.
ЭЛЕКТРО-МЕДИЦИНСКІЕ АППАРАТЫ.

Induction Coils.
Bobines d'Induction.
Carretes de Inducción.
Индукціонныя Катушки.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

X-Ray Outfits.
Radiomètres pour Rayons X.
Radiómetros para Rayos Roentgen.
Приборы для Рентгеновскихъ Лучей.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. & CO., LTD.

METERS.
COMPTEURS.
CONTADORES.
СЧЕТЧИКИ.

ARON ELECTRICITY METER, LTD.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

Ampère-Hour Meters.
Ampères-Heures-Mètres.
Contadores de Amperios-Horas.
Счетчики Амперъ-Часовъ.
ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

Watt-Hour Meters.
Watts-Heures-Mètres.
Contadores de Vatio-Horas.
Счетчики Ваттъ-Часовъ.
ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
NALDER BROS. & THOMPSON, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

MINES, Equipments for.
Equipement pour **MINES.**
Equipos para **MINAS.**
РУДНИЧНЫЯ Оборудованія.
BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
FRASER & CHALMERS, LTD.
GLOVER, W. T., & CO., LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
VICKERS, LTD.
WEST, ALLEN, & CO., LTD.

Flameproof Motors.
Moteurs Etanches au Gaz.
Motores Estancos al Gas.
Газонепроницамые Безопасные Моторы.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILSON-WOLF ENGINEERING CO., LTD

Haulage Gear.
Appareils de Halage.
Aparatos de Tracción.
Транспортныя Устройства.
BRITISH ELECTRIC PLANT CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PARSONS, C. A., & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
VICKERS, LTD.

Winding Engines.
Machines d'Extraction.
Máquinas de Extracción.
Рудничныя Лебедки.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
FRASER & CHALMERS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Mine and Watertight Fittings, see " Fittings for Electric Light."
Accessoire Estanches pour Mines, voir " Accessoires pour Lumière Electrique."
Accesorios Estancos para Minas, véase "Accesorios para Luz Eléctrica."
Рудничныя Водонепроцинаемыя Принадлежности, см. ,,Принадлежности для Электр. Освѣщ".

Mining Switchgear, see " Switchgear."

Appareils de Distribution pour Mines, voir "Appareils de Distribution."

Aparatos de Distribución para Minas, véase " Aparatos de Distribución."

Рудничныя Распредѣлительныя Устройства, см. ,,Распр. Устройства".

Mine and Sinking Pumps, see " Pumps."

Pompes d'Exhaure pour Mines, etc., voir " Pompes."

Bombas para Minas, Pozos, etc., véase " Bombas."

Рудничные и Артезіанскіе Насосы, см. ,,Насосы".

Miners' Safety Lamps, see " Lamps."

Lampes de Sûreté de Mineurs, voir " Lampes."

Lámparas de Seguridad de Mineros, véase "Lámparas."

Рудничныя Лампы, см. ,,Лампы".

MOTORS for A.C. and D.C.

MOTEURS pour C.C. et C.A.

MOTORES para C.C. y C.A.

МОТОРЫ для Перем. и Пост. Тока.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Crane Motors.

Moteurs de Grues.

Motores de Grúas.

Крановые Моторы.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Lift Motors.

Moteurs d'Ascenseurs.

Motores para Ascensores.

Лифтовые Моторы.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Motor Converters, see " Converters (Motor)."

Transformateurs en Cascade, voir ce mot.

Transformadores en Cascada, véase esta palabra.

Каскадные Конвертеры, см. это слово.

Motor Starters and Panels, see " Control Gear."

Motors, Petrol, see " Prime Movers."

Moteurs à Essence, voir " Machines Motrices."

Motores de Bencina, véase " Máquinas-Motoras."

Бензиновые Двигатели, см. ,,Двигатели".

Motors, Tramway and Railway, see " Traction."

Moteurs pour Tramways et Chemins de Fer, voir " Traction."

Motores para Tranvias y Ferrocarriles, véase " Tracción."

Трамвайные и Желѣзнодорожные Моторы, см. „Подвижные Составы".

NOVELTIES, Advertising and other.

NOUVEAUTES pour Réclames, etc.

NOVEDADES para Reclamos, etc.

НОВОСТИ для Рекламныхъ Цѣлей и др.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

PENDANTS, see " Fittings."

LAMPES à SUSPENSION, voir " Garnitures."

LAMPARAS de SUSPENSION, véase " Guarniciones."

ПОДВѢСНЫЯ ЛАМПЫ, см. „Гарнитуры".

PHOTOMETERS.

PHOTOMETRES.

FOTOMETROS.

ФОТОМЕТРЫ.

ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.

PRIME MOVERS.

MACHINES MOTRICES.

MAQUINAS-MOTORAS.

ДВИГАТЕЛИ.

Diesel Engines.

Moteurs Diesel.

Motores Diesel.

Двигатели Дизеля.

BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
HICK, HARGREAVES & CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON, LTD.

Gas Engines.

Moteurs à Gaz.

Motores de Gas.

Газовые Двигатели.

ALLEN, W. H., SON & CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
RICHARDSONS, WESTGARTH & CO., LTD.

Petrol and Oil Engines.

Moteurs à Pétrole et à Essence.

Motores de Bencina y de Aceite.

Бензиновые и Нефтяные Двигатели.

ALLEN, W. H., SON & CO., LTD.
BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.

Reciprocating Steam Engines.

Machines à Vapeur à Piston.

Máquinas de Vapor de Embolo.

Поршневыя Паровыя Машины.

ALLEN, W. H., SON & CO., LTD.
ASHWORTH & PARKER.
BELLISS & MORCOM, LTD.
BROTHERHOOD, PETER, LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
HOWDEN, JAMES, & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
SANDYCROFT, LTD.

Steam Turbines.

Turbines à Vapeur.

Turbinas de Vapor.

Паровыя Турбины.

ALLEN, W. H., SON & CO., LTD.
BELLISS & MORCOM, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
FRASER & CHALMERS, LTD.
GREENWOOD & BATLEY, LTD.
HOWDEN, JAMES, & CO., LTD.
PARSONS, C. A., & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.

Water Turbines.

Turbines Hydrauliques.

Turbinas Hidráulicas.

Водяныя Турбины.

ASHWORTH & PARKER.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FRASER & CHALMERS, LTD.

PUMPS.

POMPES.

BOMBAS.

НАСОСЫ.

Centrifugal Pumps.

Pompes Centrifuges.

Bombas Centrifugas.

Центробѣжные Насосы.

ALLEN, W. H., SON & CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.

BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

Plunger Pumps.
Pompes à Piston.
Bombas de Embolo.
Плунжерные Насосы.

CLARKE, CHAPMAN & CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
FRASER & CHALMERS, LTD.
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
SANDYCROFT, LTD.
WORTHINGTON PUMP CO., LTD.

Rotary Pumps.
Pompes Rotatives.
Bombas Rotativas.
Ротацiонные Насосы.

ALLEN, W. H., SON & CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
MATHER & PLATT, LTD.
MIRRLEES WATSON CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

Sinking Pumps.
Pompes d'Exhaure.
Bombas para Minas.
Рудничные Насосы.

BRITISH ELECTRIC PLANT CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WORTHINGTON PUMP CO., LTD.

Turbine Pumps for High Lifts.
Pompes à Turbines Etagées pour H.P.
Bombas de Turbina en Grados para A.P.
Турбо-Насосы для Высокаго Давленія.

ALLEN, W. H., SON & CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

PUSHES, see " Accessories."
BOUTONS, voir " Accessoires."
BOTONES, véase " Accesorios."
ЗВОНКОВЫЯ КНОПКИ, см. ,,Принадлежности".

PYROMETERS.
PYROMETRES.
PIROMETROS.
ПИРОМЕТРЫ.

CROMPTON & CO., LTD.
PAUL, ROBERT W.
SIEMENS BROS. & CO., LTD.

RADIATORS, see also " Heating and Cooking."
RADIATEURS, voir aussi " Chauffage et Cuisine."
RADIADORES, véase también " Caldeo y Cocina."
РАДІАТОРЫ, см. также ,,Отопленіе Кухонные Приборы".

BERRY, SKINNER & CO.
BRITISH ELECTRIC TRANSFORMER CO., LTD
BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

RADIATOR LAMPS, see " Lamps."
LAMPES pour RADIATEURS, voir " Lampes."
LAMPARAS para RADIADORES, véase " Lámparas."
ЛАМПЫ для РАДІАТОРОВЪ, см. Лампы.

REFLECTORS, see " Fittings for Electric Light."
REFLECTEURS, voir " Accessoires pour Lumière Electrique."
REFLECTORES, véase " Accesorios para Luz Eléctrica."
РЕФЛЕКТОРЫ, см. ,,Принадлежности для Электр. Свѣта".

RELAYS, see also " Instruments " and " Control Gear."
RELAIS, voir " Instruments " et " Appareils Contrôleurs."
RELEVADORES, véase " Instrumentos " y " Aparatos de Comprobación."
РЕЛЭ, см. ,,Инструменты" и ,,Контрольные Аппараты".

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
NALDER BROS. & THOMPSON, LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. & CO., LTD.
SWITCHGEAR & COWANS, LTD.

RHEOSTATS, see "Control Gear."
RHEOSTATS, voir "Appareils Contrôleurs."
REOSTATOS, véase "Aparatos de Comprobación."
РЕОСТАТЫ, см. „Контрольные Аппараты".

ROLLING MILLS, Electrical Equipment of.
Equipement Electrique de **LAMINOIRS.**
Equipos Eléctricos de **LAMINADORES.**
ВАЛЬЦОВКИ, ихъ Электр. Оборудованіе.

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC CONTROL, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

ROTARY CONVERTERS, see "Converters, Rotary."
COMMUTATRICES, voir ce mot.
CONVERTIDORES ROTATORIOS, véase esta palabra.
ВРАЩАЮЩІЕСЯ КОНВЕРТЕРЫ (ПРЕОБРАЗОВАТЕЛИ), см. „Конвертеры".

SAFETY LAMPS, see "Lamps."
LAMPES de MINEURS, voir "Lampes."
LAMPARAS de MINEROS, véase "Lámparas."
БЕЗОПАСНЫЯ ЛАМПЫ, см. Лампы.

SEARCHLIGHT PROJECTORS.
PROJECTEURS.
PROYECTORES.
ПРОЖЕКТОРЫ.

BRITISH THOMSON-HOUSTON CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
PARSONS, C. A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

SHADES, see "Fittings" and "Glassware."
ABAT-JOUR, voir "Accessoires" et "Verreries."
PANTALLAS, véase "Accesorios" y "Cristalería."
АБАЖУРЫ, см. „Принадлежности" и „Стеклянная Посуда".

SHIP INSTALLATIONS, Electric.
INSTALLATIONS Electriques pour **NAVIRES.**
INSTALACIONES Eléctricas para **BUQUES.**
СУДОВЫЯ Электрическія ОБОРУДОВАНІЯ.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
ELLIOTT BROTHERS.
GENERAL ELECTRIC CO., LTD.
HOWDEN, JAMES, & CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PARSONS, C. A., & CO.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.

Ships' Telegraph.
Télégraphes de Navires.
Télégrafos para Buques.
Судовые Телеграфы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
ELLIOTT BROTHERS.
EVERSHED & VIGNOLES, LTD.
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. & CO., LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.

Shipyard Cranes and Winches.
Grues et Treuils pour Chantiers de Construction Navale.
Grúas y Tornos para Astilleros.
Краны и Лебедки для Верфей.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.

SIGNALLING for RAILWAYS, Electrically operated.
SIGNALISATION Electriques pour **CHEMINS de FER.**
SEÑALES Eléctricos para **FERROCARRILES.**
ЖЕЛѢЗНОДОРОЖНАЯ СИГНАЛИЗАЦІЯ, Электр.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD

SIGNALS, Fire Alarms, etc.
SIGNAUX, Avertisseurs d'Incendie, etc.
SEÑALES, Alarmas de Incendio, etc.
СИГНАЛЫ, Пожарные и др.

GENERAL ELECTRIC CO., LTD
SIEMENS BROS. & CO., LTD.

SIGNS, Electrically Illuminated.
RECLAMES Lumineuses Electriques.
RECLAMOS Luminosos Eléctricos.
ВЫВѢСКИ Электрическiе.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

STARTERS and STARTING PANELS, see "Control Gear."
DEMARREURS et TABLEAUX de DEMARRAGE, voir "Appareils Contrôleurs."
APARATOS y CUADROS de ARRANQUE, véase "Aparatos de Comprobación."
ПУСКОВЫЕ РЕОСТАТЫ и ДОСКИ, см. ,,Контрольные Аппараты".

STEAM ENGINES and STEAM TURBINES, see "Prime Movers."
MACHINES et TURBINES à VAPEUR, voir "Machines Motrices."
MAQUINAS y TURBINAS de VAPOR, véase "Máquinas-Motoras."
ПАРОВЫЯ МАШИНЫ и ТУРБИНЫ, см. ,,Двигатели".

STORAGE, Electrical, see "Accumulators."
ACCUMULAGE d'Electricité, voir "Accumulateurs."
ALMACENAJE de Electricidad, véase "Acumuladores."
АККУМУЛЯЦIЯ Электричества, см. ,,Аккумуляторы".

SWITCHES, see "Accessories" and "Switchgear."
INTERRUPTEURS, voir "Accessoires" et "Appareils de Distribution."
INTERRUPTORES, véase "Accesorios" y "Aparatos de Distribución."
ВЫКЛЮЧАТЕЛИ, см. ,,Принадлежности" и ,,Распредѣлительныя Устройства".

SWITCHGEAR, SWITCHES and SWITCHBOARDS for Mining, Industrial and General Power Purposes.
APPAREILS de DISTRIBUTION, INTERRUPTEURS et TABLEAUX de DISTRIBUTION pour Mines, Usines et Centrales.
APARATOS de DISTRIBUCION, INTERRUPTORES y CUADROS de DISTRIBUCION para Minas, Fábricas y Centrales.
РАСПРЕДѢЛИТЕЛЬНЫЯ УСТРОЙСТВА и ДОСКИ для Рудниковъ, Промышленныхъ и общихъ Цѣлей.

BERRY, SKINNER & CO.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC CONTROL, LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
MORRIS & LISTER, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
VENNER & CO. (Time Switches).
WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

Accumulator Switches (Battery Regulating Switches).
Réducteurs d'Accumulateurs (Réducteurs de Batterie).
Reductores de Acumuladores (Reductores de Batería).
Аккумуляторные Коммутаторы (Элементные Коммутаторы).

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.

WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

Circuit Breakers.
Interrupteurs à Levier.
Interruptores de Palanca.
Рычажные Выключатели.

BERRY, SKINNER & CO.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELLISON, GEORGE, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MORRIS & LISTER, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Knife Switches.
Interrupteurs à Couteau.
Interruptores de Cuchillo.
Рубильники.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ECKSTEIN, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

TELEGRAPH APPARATUS.
APPAREILS TELEGRAPHIQUES.
APARATOS TELEGRAFICOS.
ТЕЛЕГРАФНЫЕ АППАРАТЫ.

ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. & CO., LTD.

Telegraphy, Wireless, see "Wireless Telegraphy."
Télégraphie sans Fil, voir "Radio-Télégraphie."
Telegrafia sin Alambres, véase "Radio-Telegrafía."
Безпроволочный Телеграфъ, см. ,,Радіо-Телегр. Аппараты".

TELEPHONES.
TELEPHONES.
TELEFONOS.
ТЕЛЕФОНЫ.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Automatic Telephones.
Téléphones Automatiques.
Teléfonos Automáticos.
Автоматическіе Телефоны.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. & CO., LTD.

TELEPHONE SWITCHBOARDS.
TABLEAU COMMUTATEURS pour TELEPHONES.
CUADROS CONMUTADORES para TELEFONOS.
ТЕЛЕФОННЫЕ КОММУТАТОРЫ.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. & CO., LTD.

TERMINALS, see "Accessories."
BORNES, voir "Accessoires."
BORNAS, véase "Accesorios."
ЗАЖИМЫ, см. ,,Принадлежности".

TESTING SETS, see also "Instruments."
APPAREILS de LABORATOIRE, voir aussi "Instruments."
APARATOS de LABORATORIO, véase también "Instrumentos."
ПРИБОРЫ для ИСПЫТАНІЯ, см. также ,,Инструменты".

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. & CO., LTD.

TEXTILE MOTORS and EQUIPMENT.

MOTEURS et ACCESSOIRES pour l'INDUSTRIE TEXTILE.

MOTORES y ACCESORIOS para la INDUSTRIA TEXTIL.

МОТОРЫ и ОБОРУДОВАНІЯ въ ТЕКСТИЛЬНОЙ ПРОМЫШЛЕННОСТИ.

BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
WILSON-WOLF ENGINEERING CO., LTD.

THEATRE LIGHTING.

ECLAIRAGE de THEATRES.

ALUMBRADO de TEATROS.

ОСВѢЩЕНІЕ ТЕАТРОВЪ.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROTHERS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

TRACTION APPLIANCES.

MATERIEL de TRACTION.

MATERIAL de TRACCION.

ПОДВИЖНЫЕ СОСТАВЫ.

Bonds.
Eclisses.
Juntas.
Стыки.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
GLOVER, W. T., & CO., LTD.

Brakes.
Freins.
Frenos.
Тормаза.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
COLE, MARCHENT & MORLEY, LTD.

Car Bodies.
Carrosserie.
Carroceria.
Вагонные Кузовы.

BRUSH ELECTRICAL ENGINEERING CO., LTD.

Gears.
Engrenages.
Engranajes.
Приводы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
VICKERS, LTD.

Locomotives.
Locomotives.
Locomotoras.
Локомотивы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.

Motors.
Moteurs.
Motores.
Моторы.

BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Controllers, see " Control Gear."
Contrôleurs, voir " Appareils Contrôleurs."
Controleres, véase " Aparatos de Comprobación."
Контролеры, см. ,,Контрольные Аппараты".

Line Insulators, see " Insulators."
Isolateurs pour Lignes Aériennes, voir " Isolateurs."
Aisladores para Lineas Aéreas, véase " Aisladores."
Изоляторы для Трамвайныхъ Воздушныхъ Проводокъ, см. ,,Изоляторы".

Overhead Lines, see " Transmission."
Lignes Aériennes, voir " Transport d'Energie."
Lineas Aéreas, véase " Transmisión de Energía."
Воздушныя Проводки, см. ,,Передача Силы".

TRANSFORMERS for Power and Lighting.

TRANSFORMATEURS pour Force Motrice et Eclairage.

TRANSFORMADORES para Fuerza Motriz y Alumbrado.

ТРАНСФОРМАТОРЫ для Силы и Освѣщенія.

BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FERRANTI, LTD.
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Transformers for Instruments, see " Instruments."

Transformateurs pour Instruments, voir " Instruments."

Transformadores para Instrumentos, véase " Instrumentos."

Трансформаторы для Инструментовъ, см. ,,Инструменты".

TRANSMISSION LINES.

LIGNES pour le TRANSPORT d'ENERGIE.

LINEAS para la TRANSMISION de ENERGIA.

ЛИНИИ для ПЕРЕДАЧИ СИЛЫ.

Poles.

Poteaux.

Postes.

Столбы.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. & CO., LTD.

Overhead Lines, Aluminium.

Lignes Aériennes en Aluminium.

Lineas Aéreas de Aluminio.

Алюминiевыя Воздушныя Линiи.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SANDYCROFT, LTD.

Overhead Lines, Copper.

Lignes Aériennes en Cuivre.

Lineas Aéreas de Cobre.

Мѣдныя Воздушныя Линiи.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. & CO., LTD.

Insulators for Transmission Lines, see " Insulators."

Isolateurs pour Lignes de Transport d'Energie, voir " Isolateurs."

Aisladores para Lineas de Transporte de Energia, véase " Aisladores."

Изоляторы для Воздушныхъ Линiй, см. ,,Изоляторы".

TUBING, see " Conduit."

TUBES, voir " Tubes Isolants."

TUBOS, véase " Tubos Aisladores."

ТРУБКИ, см. ,,Изоляцiонныя Трубки".

TURBINES, Steam and Water, see " Prime Movers."

TURBINES à Vapeur et Hydrauliques, voir " Machine Motrices."

TURBINAS de Vapor y Hidráulicas, véase " Máquinas-Motoras."

ТУРБИНЫ, Паровыя и Водяныя, см. ,,Двигатели".

VENTILATING FANS, see " Fans."

VENTILATEURS EXTRACTEURS, voir " Ventilateurs."

VENTILADORES EXTRACTORES, véase " Ventiladores."

ВЫТЯЖНЫЕ ВЕНТИЛЯТОРЫ, см. ,,Вентиляторы".

WATER COOLING TOWERS.

TOURS REFRIGERANTES A EAU.

TORRES REFRIGERANTES POR AGUA.

ГРАДИРНИ.

PREMIER COOLER & ENGINEERING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WORTHINGTON PUMP CO., LTD.

WELDING, Electric, Appliances.

Appareils de **SOUDURE** Electrique.

Aparatos de **SOLDADURA** Eléctrica.

Аппараты для Электр. **СВАРКИ.**

CROMPTON & CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

WINCHES, see " Arc Lamps " and " Ship Installations."

TREUILS de LEVAGE, voir " Lampes à Arc " et " Installations pour Navires."

TORNOS de ELEVACION, véase " Lámparas de Arco " y " Instalaciones para Buques."

ЛЕБЕДКИ, см. ,,Дуговыя Лампы" и ,,Судовыя Оборудованiя".

WIRELESS TELEGRAPHY APPLIANCES.

APPAREILS RADIO-TELEGRAPHIQUES.

APARATOS RADIO-TELEGRAFICOS.

РАДIО-ТЕЛЕГРАФНЫЕ АППАРАТЫ.

LANCASHIRE DYNAMO & MOTOR CO., LTD.
SIEMENS BROS. & CO., LTD.

WIRES, see also " Cables."

FILS, voir aussi " Cables."

ALAMBRES, véase también " Cables."

ПРОВОДА, см. также ,,Кабели".

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

INDEX FRANCAIS.

avec la traduction en anglais des en-tête sous lesquels est arrangé alphabétiquement l'Index Général en quatre langues, voir pages 153—173.

Index Francais.

Index Francais.

ÍNDICE ESPAÑOL

con la traducción en inglés de los títulos, bajo les cuales se ha arreglado alfabéticamente el Indice General en cuatro idiomas, véase páginas 153—173.

Índice Español.

Indice Español.

Español.	Inglés.
Lineas Aéreas	Overhead Lines
Lineas para Transmisión de Energia	Transmission Lines
Linternas	Lanterns
Locomotivas	Locomotives
Debajo "Traction."	
Llaves y Cajas de Contacto	Plugs and Sockets
Debajo "Accessories."	
Llaves de Concha	Tumbler Switches
Magnetos	Magnetos
Máquinas	Engines
Debajo "Prime Movers."	
Máquinas de Extracción	Winding Engines
Debajo "Mines, Equipments for"	
Máquinas-Motoras	Prime Movers
Máquinas de Vapor de Embolo	Reciprocating Steam Engines
Debajo "Prime Movers."	
Material para Alumbrado Público	Street Fittings
Debajo "Fittings."	
Material de Tracción	Traction Appliances
Materiales Aislantes	Insulating Material
Mica	Mica
Minas, Equipos para	Mines, Equipment of
Montacargas	Hoists
Motores, Diesel	Diesel Motors
Debajo "Prime Movers."	
Motores de Aceite	Oil Engines
Debajo "Prime Movers."	
Motores Estancos al Gas	Flameproof Motors
Debajo "Mines, Equipments for"	
Motores para Ascensores	Lift Motors
Motores de Bencina	Petrol Motors
Debajo "Prime Movers."	
Motores para C.C. y C.A.	Motors for A.C. and D.C.
Motores para Ferrocarriles	Motors, Railway
Motores de Gas	Gas Engines
Debajo "Prime Movers."	
Motores-Generadores	Motor-Generators
Motores de Grúas	Crane Motors
Motores para Industria Textil	Textile Motors
Motores para Tranvias	Motors, Tramway
Novedades para Reclamos	Novelties, Advertising
Pantallas	Shades
Pantallas Artisticas	Fancy Shades
Debajo "Fittings."	
Pantallas de Vidrio	Glass Shades
Debajo "Glassware."	
Pararayos	Lightning Arresters
Pilas de encender	Ignition Cells
Debajo "Batteries."	
Pilas Hidroeléctricas	Wet Cells
Debajo "Batteries."	
Pilas Secas	Dry Cells
Debajo "Batteries."	
Pirómetros	Pyrometers
Portalámparas	Lampholders
Debajo "Accessories."	

Español.	Inglés.
Postes para Lineas Aéreas	Poles for Overhead Lines
Debajo "Transmission Lines."	
Projectores	Searchlight Projectors
Pirómetros	Pyrometers
Radiadores	Radiators
Radiadores con Elementos de Resistencia	Radiators, Non-luminous
Radiómetros para Rayos Roentgen	X-Ray Outfits
Radio-Telegrafia	Wireless Telegraphy
Reclamos Eléctricos	Signs, Electrically Illuminated
Reductores de Acumuladores	Accumulator Switches
Debajo "Switchgear."	
Reflectores	Reflectors
Debajo "Fittings."	
Relevadores	Relays
Relojes Eléctricos	Clocks, Electrically driven
Reostatos	Rheostats
Rosetones de Techo	Ceiling Roses
Debajo "Accessories."	
Señales	Signals
Señales para Ferrocarriles	Signalling for Railways
Soldadura Eléctrica	Welding, Electric
Sopladores	Blowers
Tacos de Madera	Wood Blocks
Debajo "Accessories."	
Taladros Eléctricos	Drills, Electrically driven
Taladros Portátiles	Portable Drilling Machines
Debajo "Drills."	
Teléfonos	Telephones
Teléfonos Automáticos	Automatic Telephones
Telégrafos para Buques	Ships' Telegraphs
Tornos para Astilleros	Shipyard Winches
Debajo "Ship Installations."	
Tornos de Elevación para Lámparas de Arco	Arc Lamp Winches
Debajo "Arc Lamps."	
Torres Refrigerantes por Agua	Water Cooling Tower
Tracción (Aparatos de)	Haulage Gear
Debajo "Mines, Equipments for"	
Transformadores	Transformers
Transformadores de Medida	Instrument Transformers
Tubos Aisladores	Conduits
Turbinas de Vapor y Hidráulicas	Turbines, Steam and Water
Turbo-Alternadores	Turbo-Alternators
Turbo-Dinamos de C.C.	C.C. Turbo-Generators
Debajo "Generators."	
Vatimetros	Wattmeters
Debajo "Meters."	
Ventiladores	Fans
Ventiladores Extractores	Ventilating Fans
Ventiladores de Consola	Bracket Fans
Ventiladores de Mesa	Table Fans
Ventiladores de Techo	Ceiling Fans

РУССКІЙ УКАЗАТЕЛЬ

съ переводомъ на англійскій языкъ, по алфавиту котораго составленъ Общій Указатель на четырехъ языкахъ, см. стран. 153—173.

Русскій Указатель.

По-Русски.	По-Англійски.
Рефлекторы	**Reflectors**
Подъ "Fittings."	
Розетки для Потолковъ	**Ceiling Roses**
Подъ "Accessories."	
Ротаціонные Насосы	**Rotary Pumps**
Рубильники	**Knife Switches**
Рудничныя Гарнитуры	**Mines, Equipments for**
Рудничныя Лебедки	**Winding Engines**
Подъ "Mines, Equipments for."	
Рудничные Насосы	**Mining Pumps**
Рудничныя Оборудованія.	**Mines, Equipments for**
Ручныя Лампы	**Hand Lamps**
Самопишущіе Приборы	**Recording Instruments**
Сварки и ихъ Аппараты Электр.	**Welding, Electric Appliances**
Сверлильные Станки Электр.	**Drills, Electrically driven**
Сигналы	**Signals**
Слюда	**Mica**
Снаряженіе для Крановъ.	**Crane Equipments**
Соединенія (Растяж.)	**Expansion Joints**
Станки (Сверл.)	**Drilling Machines**
Стеклянная Посуда	**Glassware**
Стеклянные Абажуры	**Glass Shades**
Подъ "Glassware."	
Столбы для Воздушнихъ Проводокъ	**Poles for Overhead Lines**
Подъ "Transmission Lines."	
Столбы для Дуговыхъ Лампъ	**Arc Lamp Standards**
Стыки	**Bonds**
Подъ "Traction Appliances."	
Судовыя Электрическія Оборудованія	**Ship Installations, Electric**
Судовые Телеграфы	**Ships' Telegraph**
Сухіе Элементы	**Dry Cells**
Подъ "Batteries."	
Счетчики	**Meters**
Счетчики Амперъ-Часовъ	**Ampère-Hour Meters**
Подъ "Meters."	
Счетчики Ваттъ-Часовъ	**Watt-Hour Meters**
Подъ "Meters."	
Счетчики-Интеграторы	**Integrating Instruments**
Подъ "Instruments."	
Телеграфные Аппараты	**Telegraph Apparatus**
Телефоны	**Telephones**

По-Русски.	По-Англійски.
Телефонные Кабели	**Telephone Cables**
Телефонные Коммутаторы	**Telephone Switchboards**
Тигли	**Crucibles**
Тормаза	**Brakes**
Подъ "Traction Appliances."	
Трамвайные Моторы	**Motors, Tramway**
Транспортныя Устройства	**Haulage Gear**
Подъ "Mines, Equipment for."	
Трансформаторы	**Transformers**
Турбины	**Turbines**
Трубки	**Tubing and Conduits**
Подъ "Conduits."	
Турбо-Альтернаторы	**Turbo-Alternators**
Турбо-Генераторы Пост. Тока	**Continuous Current Turbo-Generators**
Подъ "Generators."	
Турбо-Насосы для Высокаго Давленія	**Turbine Pumps for High Lifts**
Подъ "Pumps."	
Угли	**Carbons**
Угли для Дуговыхъ Лампъ	**Carbons for Arc Lamps**
Угольныя щетки	**Brushes, Carbon**
Подъ "Carbons."	
Уличное Освѣщеніе	**Street Fittings**
Подъ "Fittings."	
Фарфоровые Изоляторы	**Porcelain Insulators**
Подъ "Insulators."	
Фильтры (Воздушные)	**Air Filters**
Фонари	**Lanterns**
Фотометры	**Photometers**
Центробѣжные Насосы	**Pumps, Centrifugal**
Часы (Электрическіе)	**Clocks, Electrically driven**
Шары для Дуговыхъ Лампъ	**Arc Lamp Globes**
Щетки (Угольныя)	**Brushes, Carbon**
Электро-Магниты	**Magnets, Lifting**
Электро-Медицинскіе Аппараты	**Medical, Electro- Appliances**
Элементы	**Cells and Batteries**

INDEX TO COMPANIES IN CLASSIFIED DIRECTORY

NAME.	Head Offices or Works.	Telegraphic Address	Codes Used
*ALLEN WEST & CO., LTD.	Lewes Road, Brighton	Control, Brighton	5th Edition, A.B.C.
ALLEN, W. H., SON & CO., LTD.	Queen's Engineering Works, Bedford	Pump, Bedford	A.B.C. 5th Edition, A1 Engineering, Broomhall Imperial Atom, Western Union and Private.
ALLEY & MACLELLAN, LTD.	Sentinel Works, Polmadie, Glasgow	Alley, Glasgow	A.B.C. 5th Edition, Engineering Telegraph, Western Union.
*ARON ELECTRICITY METER, LTD.	80A, Salusbury Road, Kilburn, London, N.W.	Arronzar, London	A B C 4th and 5th Editions
ASHWORTH & PARKER	Bury, Lancs.	Kinetic	Western Union, A.B C. 5th Edition
*BELLISS & MORCOM, LTD.	Ledsam Street Works, Birmingham	Belliss, Birmingham	A.B.C. 5th Edition, Engineering 2nd Edition, Western Union (Universal Edition), Lieber's.
*BERRY, SKINNER & CO.	78, Upper Thames Street, London, E.C	Ptolemaist	A B C Code 4th and 5th Editions
,, ,, ,,	Suffolk Works, Oozells Street, Birmingham	,,	Western Union, Universal Edition.
*BOOTHROYD H. T., LTD	Bootle, Liverpool	Commutator, Liverpool.	———————
BRAY, MARKHAM & REISS, LTD.	Blackhorse Lane, Walthamstow, N.E.	Bramaria, Walthill, London	———————
*BRITISH ELECTRIC PLANT CO., LTD.	78 St. Vincent Street, Glasgow	Bepco, Glasgow	A.B.C. 5th Edition.
*BRITISH ELECTRIC TRANSFORMER CO., LTD	Hayes, Middlesex, and 48, Oxford Street, London, W.	Transfundo, Hayes, Middlesex	A.B C. 5th Edition, Western Union Engineering, 2nd Edition.
*BRITISH THOMSON-HOUSTON CO., LTD.	Rugby England	Asteroidal Rugby; Solutrix, London	Lieber, A.B.C. and Western Union
,, ,, ,, ,,	Mazda House, 77, Upper Thames Street, E.C.	Mazdalux, Cannon, London	Lieber's A B C
*BRITISH WESTINGHOUSE ELECTRIC & M'F'G. CO., LTD.	Trafford Park, Manchester	Westinghouse, Manchester	A.B.C. 5th Edition, Western Union Lieber's.
*BROOK, HIRST & CO., LTD.	Northgate Electrical Works, Chester	Switches, Chester	A.B.C. 5th Edition.
BROTHERHOOD, PETER, LTD.	Peterborough	Brotherhood, Peterborough. Brotherhood, Parl, London	A.B.C. 5th Edition.
*BROWETT, LINDLEY & CO., LTD.	Patricroft, Manchester	Sandon, Patricroft	Lieber's, A.B.C. 5th Edition, Engineering.
*BRUSH ELECTRICAL ENGINEERING CO., LTD.	Falcon Works, Loughborough, Leicestershire	Falcon, Loughborough.	A.B C. 5th Edition, A1, Western Union, Engineering.
,, ,, ,, ,,	LONDON OFFICE:—1, Kingsway, London, W.C	Magneto, London.	,, ,, ,,
*CALLENDER'S CABLE & CONSTRUCTION CO., LTD.	Hamilton House, Victoria Embankment, London, E.C.	Callender, Fleet, London	———————
CHAMBERLAIN & HOOKHAM, LTD.	Solar Works, Birmingham	Solar, Birmingham	ABC. 5th Edition, Western Union
*CLARKE, CHAPMAN & CO., LTD.	Gateshead-on-Tyne	Cyclops, Gateshead	A.B.C. 4th and 5th Editions, A1, Engineering 1st and 2nd Editions, Lieber's, Broomhall's, Moreing and Neil's, Watkins, Western Union and Private.
*COLE, MARCHENT & MORLEY, LTD.	Wakefield Road, Bradford, England	Cole, Bradford	A1, A.B.C. 5th Edition, Engineering 1st and 2nd Editions, Western Union, Lieber's.
CREDENDA CONDUITS CO., LTD.	Chester Street, Aston, Birmingham	Credenda, Birmingham	———————
*CROMPTON & CO., LTD.	Salisbury House, London Wall, E.C.	Crompton, Ave, London	Bentley, A.B.C. 5th Edition, Lieber's.
DAY, ST. JOHN, (PATENTS), LTD.	Bank Mills Morton Street, Oldham	Day, 305 Oldham	A.B.C. 5th Edition.
*DICK, KERR & CO., LTD.	Abchurch Yard, Cannon Street, E.C.	Dicker, London	Bentley, Western Union, Lieber's A.B.C. 5th Edition
D-P. BATTERY CO., LTD.	Lumford Mills, Bakewell, Derbyshire, and 11, Victoria St., Westminster, S W.	Battery, Bakewell; Cumulose, London	A.B.C. 5th Edition, New Business, Private.
*ECKSTEIN, HEAP & CO., LTD.	Lancashire Switchgear Works, Broughton, Manchester	Electron	———————
*EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.	Ponders End Middlesex	Ediswan, Ponders End.	———————
ELECTRICAL APPARATUS CO., LTD.	Vauxhall Works, South Lambeth Road, London, S.W.	Elapratus, London	A.B.C. 5th Edition
*ELECTRICAL ENGINEERING AND EQUIPMENT CO., LTD.	Bank Buildings, 109-11, New Oxford Street, London, W.C.	Thermotype, Westcent, London	A.B.C. 5th Edition.
*ELECTRIC CONTROL LTD.	177, Reid Street, Glasgow, and	Control, Glasgow	———————
	Queen Anne's Chambers, Westminster, S.W.	Autoswitch, Vic, London	A.B.C. 5th Edition.
*ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.	Cheston Road, Aston, Birmingham	E.O.A. Birmingham	A B.C. 5th Edition.

NAME.	Head Offices or Works.	Telegraphic Address.	Codes Used.
*ELECTROMOTORS, LTD............	Openshaw, Manchester...........................	Magnet, Manchester...	A.B.C. 5th Edition.
*ELLIOTT BROTHERS...............	1, Central Buildings, Westminster, S.W............	Elliottize, London.....	A.B.C. 5th Edition.
ELLISON, GEORGE	Victoria Works, Warstone Lane, Birmingham.......	Induction, Birmingham	Western Union, Lieber's and Engineering.
*EVERETT, EDGCUMBE & CO., LTD.	117, Victoria Street, London, S W.	Everectus Sowest, Ldn	A.B.C. 5th Edition
" " " " ...	Factory :—Collindale Works, Hendon, N.W.	Evergendos Hyde, Ldn.	————————
*EVERSHED & VIGNOLES LTD.....	Acton Lane Works, Chiswick, London, W...........	Dorothea, London.....	A.B C. 5th Edition, Western Union (Universal Edition), Eng. 2nd Ed
*FERRANTI, LTD....................	Central House, Kingsway, London, W.C	Ferranti, Westcent, London; Cables—Ferranti, London.......	A.B.C. 4th and 5th Editions, A1 Cole, Engineering, Lieber's, Western Union.
" "	Works :—Hollinwood, near Manchester............	————————	" " "
*FRASER & CHALMERS, LTD.	Erith, Kent	Vanner, Erith	A.B.C. 4th and 5th Editions, Moreing and Neal, Broomhalls, Imperial, Western Union.
*GENERAL ELECTRIC CO. LTD.....	67, Queen Victoria Street, London, E.C.	Electricity Cables, Polyphase	A.B.C Lieber's, Western Union.
GLOVER, W. T., & CO., LTD........	Trafford Park, Manchester.......................	Cables, Manchester....	A.B.C. 5th Edition, Lieber's, Western Union and Private Code.
*GREENWOOD & BATLEY, LTD	Albion Works, Armley Road, Leeds................	Greenwood, Leeds	A.B.C. 4th and 5th Editions, Lieber's, Engineering 1st and 2nd Editions, A1 Western Union and Bentley's.
*HENLEY'S, W. T., TELEGRAPH WORKS, LTD	Blomfield Street London, E.C...................	Inland, Henletel Ave, London; Cables—Henleys, London....	Western Union, A.B.C., 5th Edition Lieber's and Private.
*HICK HARGREAVES & CO., LTD	Soho Iron Works, Bolton........................	Hick, Bolton	A.B.C 5th Edition, A1 (1888), Western Union, Lieber's Standard.
*HOWDEN, JAMES & CO., LTD.	195, Scotland Street, Glasgow....................	Howden, Glasgow	A.B.C. 5th Edition, Western Union.
*IGRANIC ELECTRIC CO., LTD.....	147, Queen Victoria Street, London, E.C..........	Igranic	Lieber's and Private.
" "	Work:—Bedford, England	————————	————————
*JANDUS ARC LAMP & ELECTRIC CO., LTD.	Hartham Road, Holloway, London, N.	Jandunus, Holway, London	A.B.C. 5th Edition.
*JOHNSON & PHILLIPS, LTD.	Victoria Works, Charlton, London, S.E............	Juno Charlton, Kent..	A.B.C., 5th Edition, A1, 5th Edition, Engineering, Lieber's, Western Union.
*LANCASHIRE DYNAMO & MOTOR CO., LTD..........................	Trafford Park, Manchester.......................	Ironclad, Manchester..	A.B.C. 5th Edition, Western Union Engineering, Cole's
LIVERPOOL ELECTRIC CABLE CO., LTD.	Linacre Lane, Bootle, Liverpool	Concentric, Liverpool..	A.B.C. 5th Edition.
LUCY & CO., W., LTD.	Eagle Ironworks, Oxford	Lucy, Oxford	————————
*LUNDBERG, A. P., & SONS........	477-489, Liverpool Road, London, N	Lundberg, London....	A.B.C 5th Edition.
*MATHER & PLATT, LTD	Park Works, Newton Heath, Manchester..........	Mather or Sprinkler Manchester	Western Union, Universal Edition, Lieber's, A B.C. 4th and 5th Editions, A1, M. & P. Private.
*MAVOR & COULSON, LTD.........	47, Broad Street, Mile End, Glasgow..............	Prodigious, Glasgow...	A.B.C. 5th Edition, Engineering 2nd Edition, Bentley's.
*MAWDSLEY'S, LTD................	Zone Works, Dursley, Glos......................	Zone, Dursley.........	A.B.C. 5th Edition.
*MIRRLEES WATSON CO., LTD.	45, Scotland Street, Glasgow, and 122, Cannon Street, London, E.C.	Mirrlees, Glasgow .. Mirrlees, Cannon, London	Western Union, Lieber's, Engineering, A.B.C and A1.
*MORGAN CRUCIBLE CO., LTD	Battersea Works, London, S.W...................	Crucible, Battsquare, London (two words chargeable)	A.B.C. 4th and 5th Editions A1, Lieber's and Western Union (Universal Edition).
MORRIS & LISTER, LTD...........	Carlton Works, Lockhurst Lane, Coventry..........	Carlton, Coventry.....	————————
*NALDER BROS. & THOMPSON, LTD.	97a, Dalston Lane, London, N.E.................	Occlude, Kinland, London................	Western Union.
*OSRAM-ROBERTSON LAMP WORKS LTD	Brook Green, Hammersmith, London, W..........	Electricity London. Cables—Polyphase...	A.B.C., Lieber's, Western Union and Private.
*PARK ROYAL ENGINEERING WORKS, LTD.....................	Cumberland Avenue, Willesden, London, N.W.....	Isobar, Harles, London.	A.B.C. 5th Edition
*PARSONS, C. A., & CO., LTD.	Heaton Works, Newcastle-on-Tyne................	Turbo, Newcastle-on-Tyne	A1, A.B C., Western Union.
" " " "	London Office :—8, Victoria Street, London, S.W...	Silently Vic, London...	" " "

NAME.	Head Offices and Works.	Telegraphic Address.	Codes Used.
*PAUL, ROBERT W.	Newton Avenue Works, New Southgate, N., and 1, East 42nd Street, New York, U.S.A.	Unipivot, London	———
*PEEBLES BRUCE, & CO, LTD.	Edinburgh	Peebles, Edinburgh	Western Union, A.B.C., 5th Edition New Business and Private.
*PHŒNIX DYNAMO M'F'G. CO., LTD.	Thornbury Works, Bradford	Dynamo, Bradford	A.B.C. 5th Edition and Private.
PIRELLI, LTD.	144, Queen Victoria Street, London, E.C.	Pirellicon Cent, London	———
*PREMIER COOLER & ENGINEERING CO., LTD.	Broadway Court, Broadway, Westminster, S.W.	Precooler, Vic, London	Lieber's, A.B.C. 5th Edition.
PRITCHETTS & GOLD & ELECTRICAL POWER STORAGE CO., LTD.	82, Victoria Street, London, S.W.	Acidulated, Sowest, London	Bentley's or A.B.C.5th Editio n.
REASON MANUFACTURING CO., LTD.	Lewes Road, Brighton	Reason, Brighton	A.B.C. 5th Edition.
*RECORD ELECTRICAL CO., LTD	Caxton House, Westminster	Infusion, London	A.B.C. 5th Edition and Bentley's.
" " " "	WORKS:—Broadheath, Manchester	———	———
*REES ROTURBO MANUFACTURING CO., LTD.	Wolverhampton	Roturbo, Wolverhampton	Engineering 2nd Edition, A1 Western Union, A.B.C. 5th Edition.
*REYROLLE A., & CO., LTD	Hebburn-on-Tyne, England	Reyrolle, Hebburn	A.B.C. 5th Edition, Western Union (Universal Edition) and New Business.
*RHODES MOTORS, LTD.	Riverside Works, Doncaster	Rhodique, Doncaster	A.B.C. 5th Edition and Private, Hamilton's Code Condenser.
*RICHARDSONS, WESTGARTH & CO., LTD.	Hartlepool	Richardsons, Hartlepool	A.B.C. 5th Edition, Western Union
SANDYCROFT LTD.	Sandycroft, near Chester	Sandycroft, Hawarden	———
SIEMENS BROS. & CO., LTD.	Telegraph Works, Woolwich	Siemens, Woolwich	A.B.C. 5th Edition, Lieber's, Western Union, Broomhall, Moreing and McCutcheon.
*SIEMENS BROS. DYNAMO WORKS, LTD.	Caxton House, Westminster, S.W.	Siembralos, Vic. London	Moreing and McCutcheon, Lieber's Western Union, A.B.C. 4th and 5th Editions, A1 Engineering.
" " " " "	38 & 39, Upper Thames Street, E.C.	Siemotor, Cent. London	" "
*SUN ELECTRICAL CO., LTD.	118-120, Charing Cross Road, London, W.C.	Secabilis Ox., London	A.B.C. 5th Edition.
*SUNDERLAND FORGE & ENGINEERING CO., LTD.	Sunderland	Marr	———
*SWITCHGEAR & COWANS, LTD.	Springfield Lane, Salford, Manchester	Control, Manchester	Western Union, A.B.C. 4th Edition.
TUDOR ACCUMULATOR CO., LTD.	3, Central Buildings, Westminster, London, S.W.	Extudorex, London	A.B.C. 5th Edition.
*VENNER & CO.	6, Old Queen Street, Westminster, London, S.W.	Trydan Vic., London	A.B.C. 5th Edition, Western Union, Marconi, Private.
*VICKERS, LTD.	Sheffield and London Westminster, S.W.	Vickers, Sheffield	A.B.C. 5th Edition, Western Union.
WESTMINSTER ENGINEERING CO., LTD.	Victoria Road, Willesden Junction, N.W.	Regency, London	A.B.C. 5th Edition.
WHIPP & BOURNE	Castleton, Manchester	Switches, Castleton, Lancs.	A.B.C. and Lieber's.
*WILLANS & ROBINSON, LTD.	Victoria Works, Rugby	Willans, Rugby	A1, Lieber's, Cole, A.B.C. 4th and 5th Eds., Eng. 2nd Ed.
*WILSON-WOLF ENGINEERING CO., LTD.	Bradford	Energy	A.B.C. 5th Edition, and Private.
*WORTHINGTON PUMP COMPANY, LTD.	India House, Kingsway, W.C.	Pumping, Estrand, London	———

* See announcement in advertisement pages, which are arranged alphabetically.
* Voir les pages des annonces placées par ordre alphabétique.
* Véanse las páginas continiendo los anuncios en órden alfabético.
* Si vedano le pagine degli annunzi posti per ordine alfabetico.
* См. въ объявленіяхъ, расположенныхъ по алфавиту.

EXTRACTO DE LAS REGLAS BRITANICAS CORRIENTES RELATIVAS A MÁQUINAS ELÉCTRICAS Y TRANSFORMADORES

(Exclúyense los motores de tracción)

NOTA: Las reglas completas han sido publicadas en inglés y francés bajo el título de *Report No. 72 of the Engineering Standards Committee* (Informe No. 72 de la Comisión para fijar normas de ingeniería) ;pueden adquirirse en cualquier librería o en la oficina de la Comisión, situada en 28 Victoria Street, Westminster, Londres, S.W., Inglaterra.

CONTENIDO: Regla general—Planchas descriptivas—Clasificación—Sobrecargas en el servicio—Período de prueba para elevación de temperatura—Límites de la elevación de temperatura—Pruebas de alta presión—Pruebas de sobrecarga—Pruebas de conmutación.

APÉNDICE: Presiones corrientes o normales—Tipos de máquinas.

REGLAS

1. REGLA GENERAL.—Las máquinas y transformadores normales a que se refieren estas reglas pueden funcionar con cualquier temperatura de aire refrigerativo que no pase de 40° C., y a cualquier altura no menor de 1000 metros.

2. PLANCHAS DESCRIPTIVAS.—En cada máquina o transformador se colocará una plancha que indique exactamente el rendimiento eléctrico o mecánico y los datos relativos al circuito eléctrico en que ha de funcionar.

3. CLASIFICACIÓN.—Hay dos clases corrientes de máquinas o transformadores:

(a) DE RENDIMIENTO CONTINUO, o sea en que la producción puede mantenerse por tiempo ilimitado, sin que la elevación de temperatura exceda los límites mencionados en las cláusulas 6 y 7; y

(b) DE RENDIMIENTO LIMITADO (para servicio intermitente), en que la señalada producción puede mantenerse durante el tiempo indicado en la plancha, sin que la elevación de temperatura pase de los límites dados en las cláusulas 6 y 7.

Períodos de una o media hora se consideran como normales o corrientes.

4. SOBRECARGAS EN EL SERVICIO.—La carga obtenida de la máquina en servicio debe ser tal que nunca se excedan los límites de la elevación de temperatura indicados en las cláusulas 6 y 7.

5. EL PERÍODO DE PRUEBA PARA LA ELEVACIÓN DE TEMPERATURA de máquinas y transformadores cuando funcionan de acuerdo con lo previsto para ellos, ha de medirse:—

(a) Para los de rendimiento continuo, después que la elevación de temperatura esté casi constante: (En el caso de máquinas, basta de ordinario un periodo de 6 horas.)

(b) Para los de rendimiento limitado (empezando en frío), después del recorrido indicado en la plancha.

6. LÍMITES DE LA ELEVACIÓN DE TEMPERATURA.—

(a) En el caso de arrollamientos aislados con algodón saturado, papel saturado o esmalte, los límites permisibles de la elevación de temperatura son los que muestra el cuadro que estampamos adelante.

(b) Tratándose de arrollamientos aislados con mica o asbesto (salvo para transformadores sumergidos en aceite), los límites permisibles de la elevación de temperatura son 20° C. sobre los que indica el precitado cuadro.

Cuando el aislamiento está hecho de diferentes materiales, se adoptará como límite de la elevación de temperatura la más baja que se permite para cualquiera de aquéllos ; pero no se cuenta como parte del aislamiento incluído en esta regla el usado en pequeñas cantidades en la construcción y que no sirve continuamente de sostén para el aislamiento.

MÁQUINAS Y TRANSFORMADORES ARROLLADOS HASTA 5000 VOLTIOS.

Nombre de la parte.	Máxima elevación permisible de temperatura.	Medido por.
MÁQUINAS :		
Bobinas del inductor excitadas por corriente continua	55° C.	Resistencia [1]
(Exceptúanse las bobinas en serie del inductor)	(55° C.)	(Termómetro)
Inducidos rotatorios con conmutadores	50° C.	Termómetro
Arrollamientos en ranuras, fijos o rotatorios	55° C. ó 50° C.	Resistencia Termómetro solamente.
Arrollamientos en cortocircuito, aislados	60° C.	Termómetro
Arrollamientos en cortocircuito, no aislados	[2]	—
Conmutadores y anillos corredizos	50° C.	Termómetro
Núcleos de hierro	Lo mismo que para los arrollamientos encastrados en el núcleo.	Termómetro.
TRANSFORMADORES :		
Arrollamientos	55° C.	Resistencia
Aceite	50° C.	Termómetro
Núcleo de hierro	Lo mismo que para los arrollamientos en aceite.	Termómetro

NOTA : Los límites de la elevación de temperatura para el algodón o papel que no están saturados son 10°C. más bajos que los señalados en el cuadro. (Material sumergido en aceite se considera como saturado.)

(1) Durante la guerra los fabricantes de la Gran Bretaña continuarán midiendo por termómetro la elevación de temperatura de todas las bobinas del inductor (excepto las de los turboalternadores); la permisible elevación de temperatura es 50° C.

(2) No debe ser tal que haya riesgo de daño para cualquier material aislante o partes adyacentes.

7. ARROLLAMIENTOS PARA MÁS DE 5000 VOLTIOS.—Los límites de la elevación de temperatura señalados en la cláusula 6a. deben reducirse $1\frac{1}{2}°$ C. por cada 1000 voltios sobre 5000. Esto no se refiere a los transformadores.

8. PRUEBAS DE ALTA PRESIÓN APLICABLES DURANTE UN MINUTO:

PARA MÁQUINAS Y TRANSFORMADORES:	Prueba de presión:
Menos de 746 vatios ó 1 caballo de vapor ...	500 voltios más el doble de la presión señalada.
746 vatios ó 1 c. de v., y cantidades mayores ...	1000 voltios más el doble de la presión señalada.

PARA TRANSFORMADORES QUE ALIMENTAN CIRCUITOS DOMÉSTICOS:

Lado de alta tensión si es para 2000 voltios o más	No menos de 10.000 voltios.
Si para menos de 2000 voltios...	5000 voltios.
Lado de baja tensión	1000 voltios más el doble de la presión señalada.

9. PRUEBAS DE SOBRECARGA.—Estas pruebas tienen por único objeto determinar las propiedades mecánicas y eléctricas, sin atender al calentamiento; por tanto, deben principiarse en frío o a tal temperatura que no exceda la elevación mencionada en la cláusula 6a.

(a) Para cualquier máquina de rendimiento continuo: Dos veces corriente de carga plena durante 15 minutos.

(b) Cualquier motor de inducción de rendimiento continuo: Una vez y tres cuartos carga plena del par resistente, sin parar.

(c) Para cualquier máquina de rendimiento limitado: Funcionando, Dos veces carga del par resistente durante 30 segundos. Al ponerse en marcha (salvo los motores con inducido de jaula): Dos veces carga del par resistente.

Para las pruebas (b) y (c) la presión que se aplique debe mantenerse en la cantidad señalada.

10. Pruebas de conmutación.—Una máquina de corriente continua ha de funcionar con escobilla fija, empezando sin carga hasta la más alta momentánea mencionada en la cláusula 9; y debe funcionar casi sin chispas y sin originar daño alguno a la superficie del conmutador o a las escobillas, desde el primero hasta el último momento de la prueba; y sin lanzar chispas perjudiciales ni dañar al conmutador o a las escobillas, hasta la más alta carga momentánea determinada en la cláusula 9.

APÉNDICE:

(A) Presiones corrientes.—Las máquinas ordinarias son adecuadas para las presiones siguientes:

Corriente Continua:	Corriente alternada:
110 voltios.	
220 ,,	200 voltios.
440 ,,	400 ,,
500 ,,	500 ,,

Los motores pueden funcionar bajo presiones que no excedan ni bajen más de 5 % de la presión señalada.

(B) Tipos de Máquinas (generadores y motores).—

Máquina abierta o descubierta: máquina abierta o descubierta es aquella en que la ventilación no está limitada sino por las exigencias de una buena construcción mecánica.

Máquina protegida: Entiéndese por tal una máquina con guardas para los apoyos terminales, y libre acceso al interior sin necesidad de abrir puertas ni levantar cubiertas.

Máquina semicubierta.—En esta máquina las aberturas de la ventilación en la armazón están cubiertas:

(a) Con rejas, metal extendido o tela metálica, y tienen aberturas no menores de ½ pulgada, para dejar libre paso a la ventilación.

(b) Con tela metálica en que las aberturas tienen menos de 1/4 de pulgada pero no bajan de 3/32 de pulgada, o están provistas de metal perforado con agujeros de no menos de 3/16 de pulgada (diámetro o ancho).

(c) Con rejas de aberturas más pequeñas que las anteriores.

Las máquinas de la división (c) deben sujetarse a estas reglas cuando las aberturas estén cerradas, pues éstas se obstruyen con frecuencia durante el funcionamiento.

Máquina totalmente cubierta.—Llámase así a la máquina cuya caja y apoyos están protegidos contra el polvo, y que no deja circular aire entre el interior y el exterior de la caja.

Máquina con tubo de ventilación.—Es una máquina cubierta en la cual la armazón está dispuesta de tal modo que el aire de ventilación puede trasmitirse a aquélla por medio de un tubo unido a la armadura; la ventilación se conserva por efecto de la máquina misma.

Si el aire caliente arrojado por la máquina sale por otro tubo unido a la armadura, esto debe mencionarse especialmente.

Máquina de aire forzado.—Es una máquina cubierta en la cual el suministro de aire para la ventilación se mantiene por medio de un ventilador situado fuera de la máquina misma.

Máquina a prueba de gotera.—Esta máquina posee una armadura con aberturas para la ventilación protegidas de tal suerte que no permiten la entrada de humedad o basura.

Máquina a prueba de llamas.—Es aquella cuya caja puede resistir sin daño cualquier explosión de gas que ocurra dentro de ella, y no trasmite la explosión a ningún gas inflamable que se hallare por fuera.

Una máquina en que sólo los anillos corredizos y las escobillas estén encerrados en una caja a prueba de llamas no se denomina "Máquina a prueba de llamas". Al referirse a ésta se dirá que es de "anillos corredizos a prueba de llama".

EXCERPTOS DOS

REGULAMENTOS INGLEZES COM RESPEITO AO NORMALIZAR OS MACHINISMOS E TRANSFORMADORES ELECTRICOS

(com a excepção de Motores para tracção)

⁂ Os regulamentos completos forão publicados em Inglez e Francez na forma de relatorio No. 72 do Comité de Normalisação d'engenheria, e podem obter-se em qualquer livraria ou directamente dos Escriptorios do Comité, 28 Victoria Street, Westminster, Londres, S.W.

INDICE: Regulamentos geraes—Placas nominativas—Classificações de Computaçõoes—Sobrecargas effectivas—Periodo de prova para augmentos de temperatura—Limites de augmentos de temperatura—Provas de alta pressão — Provas de sobre-carga — Provas de commutação.

APPENDICE: Pressões normaes—Typos de machinas.

REGULAMENTOS

(1)

GERAES.—Machinas normaes e transformadores sob estes regulamentos são capazes de funccionar com uma temperatura de ar refrigerante que não exceda a 40 graus Centigrados e a qualquer altura que não exceda de 1000 metros.

(2)

PLACAS NOMINATIVAS.—Uma placa nominativa será fixa a cada machina ou transformador indicando correctamente a sua classificação electrica ou mechanica assim como os pormenores relativos ao circuito electrico sobre o qual se pretende trabalhar.

(3)

CATEGORIAS DE CLASSIFICAÇÃO.—As categorias normaes de classificação são duas :—

(a) Computacão continua na qual a producção computada da machina ou transformador poderá effectuar-se durante um periodo

illimitado sem que a temperatura suba em excesso aos limites estipulados nas clausulas 6 e 7.

(b) Computação breve (para serviço intermittente) na qual a producção computada da machina ou do transformador poderá effectuarse durante o periodo indicado na classificação sobre a placa nominativa sem que o augmento na temperatura exceda os limites estipulados nas clausulas 6 & 7.

N'uma especificação de computação breve, são considerados como normaes os periodos de uma hora e de meia hora.

(4)

Sobrecargas Effectivas.—Ao tirar a carga de uma machina em funcção activa deve se ter cuidado em não exceder os limites de augmento de temperatura estipulados nas clausulas 6 e 7.

(5)

O Periodo de prova de augmento na temperatura. Em machinas e transformadores quando estes estejam funccionando d'acordo com a sua classificação, medir-se-ha como segue :—

(a) Para computação continua, depois do augmento na temperatura se ter tornado practicamente constante. (No caso de machinas um periodo de seis horas achar-se-ha em geral bastante.)

(b) Para Computações de breves periodos (começando-se a frio) depois do periodo de funccionamento indicado na placa nominativa.

(6)

Limites do Augmento na Temperatura :

(a) No caso de enrolamentos isolados com algodão impregnado; papel ou esmalte impregnados, os limites de augmento de temperatura permissiveis acham-se indicados na tabella seguinte.

(b) No caso de enrolamentos inteiramente isolados com mica ou asbestos, excepto no caso de transformadores embebidos em azeite, os limites permissiveis de augmento de temperatura são de 20 graus centigrados acima d'aquelles indicados na tabella.

Quando a isolação fôr composta de differentes materiaes terá que adoptar-se o augmento menor em temperatura que fôr permittido com qualquer dos varios materiaes isoladores como sendo o limite em augmento de temperatura, com a excepção d'aquelle material que se possa empregar em pequenas quantidades na obra de construcção e que não terá que servir como sustento continuo para o material isolador e que portanto não se deve considerar como sendo parte da isolação no que respeita a este regulamento.

Para Machinas e Transformadores enrolados para não mais de 5000 Volt.

Nome da peça	Augmento maximo permissivel de temperatura.	Medido por.
Para Machinas.		
Rolos do Inductor animados por corrente directa	55° C.	Resistencia. (1)
(Excepção-Rolos do Inductor de serie)	(55° C.)	(Thermometro.)
Armaduras rotativas com commutadores	50° C.	Thermometro.
Enrolamentos em frestas, estacionarios ou rotativos... ...	55° C. ou 50° C.	Resistencia Thermometro unicamente.
Enrolamentos de circuito curto-isolados	60° C.	Thermometro.
,, sem ser isolados	(2)	
Commutadores e anilhas escorregadiças	50° C.	Thermometro.
Caroços de ferro	o mesmo que para os enrolamentos embutidos no caroço	Thermometro.
Para Transformadores.		
Enrolamentos	55° C.	Resistencia.
Azeite	50° C.	Thermometro.
Caroços de ferro	o mesmo que para os enrolamentos em azeite.	Thermometro.

Nota: Os limites de augmento de temperatura no caso de algodão ou de papel não impregnados são 10° C, abaixo do valor indicado na tabella (material embebido em azeite é considerado como impregnado.)

(1) Durante a guerra os Fabricantes de Gran Bretanha continuarão a medir por thermometro a elevação de temperatura de todos os rolos do inductor (com a excepção dos dos turbo-alternadores) sendo a permissivel elevação de temperatura de 50°C.

(2) Devem ser de tal forma que não haja o menor risco de avaria a qualquer do material isolador ou partes adjacentes.

(7)

Enrolamentos Computados Para Mais de 5000 Volts.—Os limites de augmento de temperatura estipulados na clausula 6 devem reduzir-se 1-½° C. por cada 1000 volts acima de 5000. Isto não é applicavel aos transformadores.

(8)

Provas de Alta Pressão Para Serem Feitas por Durante Um Minuto.

Para Machinas e Transformadores.	Pressão de prova.
Abaixo de 746 watts ou 1 H.P. (força de cavallo)	500 volts mais duas vezes a pressão computada.
746 watts ou 1 H.P. (força de cavallo) e acima	1000 volts mais duas vezes a pressão computada.

PARA TRANSFORMADORES ALIMENTANDO

CIRCUITOS DOMESTICOS.

Lado de alta tensão, se para 2000 volts e acima	não menos de 10,000 volts.
Se menos de 2000 volts...	5,000 volts.
Lado de baixa tensão	1,000 volts mais duas vezes a pressão computada.

(9)

PROVAS DE SOBRE-CARGA.—Estas provas são destinadas a determinarem unicamente as propriedades mechanicas e electricas sem referencia alguma ao esquentamento e por consequencia devem começar-se a frio ou a uma temperatura que não deixe exceder-se o augmento de temperatura permittido pela clausula 6.

(a) Toda machina com computação continua :—

Duas vezes a corrente de carga completa por durante quinze segundos.

(b) Todo Motor de inducção com computação continua :—
uma e tres quartas vezes a carga inteira de rodete sem revestimento.

(c) Toda machina com computação de periodo curto,
Quando estiver funccionando :—

Duas vezes a carga inteira de rodete por durante 30 segundos.

Ao começar (excepto no caso de motores de inducção a caixa de esquilo ("squirrel cage")—

Duas vezes a carga inteira de rodete.

Para as provas (b) e (c) a pressão applicada deve-se manter ao valor computado.

(10)

PROVAS DE COMMUTAÇÃO.—Uma machina de corrente directa deverá funcionar com installação de escova fixa sem carga até a carga maior momentaria especificada na Clausula 9, devendo tambem marchar quasi sem centelhar e sem prejuizo á superficie do Commutador ou escovas sem carga até a carga computada, e sem centelhar prejudicial ao Commutador ou escovas até a carga momentaria mais alta especificada na Clausula 9.

APPENDICE.

A. PRESSÕES NORMAES.

As machinas geralmente em existencias são proprias para as seguintes pressões.

C.D.	C.A.
110 volts.	
220 ,,	200 volts.
440 ,,	400 ,,
500 ,,	500 ,,

Os Motores são proprios para trabalhar com pressões variando por não mais que 5 por cento por cima ou por baixo da pressão computada.

B. TYPOS DE MACHINAS (GENERADORES & MOTORES).

MACHINA ABERTA. Uma machina aberta não tem restricções de ventilação que não sejam exigidas por boa construcção mechanica.

MACHINA PROTEGIDA. Uma machina protegida tem na extremidade apoios de escudo, com livre entrada ao interior sem abrir portas nem remover cobertas.

MACHINA SEMI-INCLUSA. Uma machina semi-inclusa tem as aberturas de ventilação na armadura cobertas com

(a) Grades, metal dilatado ou gaza de arame, com aberturas de não menos de ¼ de pollegada, para não impedir a ventilação livre.

(b) Gaza de arame em que as aberturas são menos de ¼ de pollegada mas não menos de 3/32 de pollegada ou com metal furado com furos de um diametro ou largura de não menos de 3/16 de pollegada.

(c) Anteparos com aberturas menores que as acima indicadas.

As machinas na classe (c) devem satisfazer estas exigencias quando as aberturas estão fechadas, pois estas aberturas muitas vezes ficam entupidas em uso actual.

MACHINAS TOTALMENTE INCLUSAS. E' uma em que a caixa e apoios são prova a poeira, e que não permittem uma circulação de ar entre o interior e exterior da caixa.

MACHINAS COM TUBOS VENTILADOS. E' uma machina inclusa em que a armadura é arranjada de tal maneira que o ar ventilador pode ser passado por um tubo fixado á armadura, sendo mantida a ventilação pela acção ventiladora produzida pela machina mesma.

Se o ar esquentado expulso da machina é removido por um segundo tubo fixado á machina, deve-se indicar isto especialmente.

MACHINA DE CORRENTE FORÇADO. E' uma machina inclusa em que o ar de ventilação é fornecido e mantido por um ventilador independente no exterior da machina.

MACHINA PROVA DE ESGOTO. E' uma machina com uma armadura munida de aberturas para a ventilação protegidas de tal maneira a excluir a entrada de humidade e sujidade.

MACHINA PROVA DE CHAMMAS. E' uma machina cuja caixa pode resistir sem prejuizo qualquer explosão de gas que possa ocorrer por dentro, e não transmittirá a explosão a qualquer gas inflammavel exterior.

Uma machina em que as anilhas escorregadiças e escovas estão inclusas em uma caixa prova de chammas não se chama uma machina prova de chammas. Uma tal machina se chamaria machina com incluso de anilha escorregadiça prova de chammas.

DE INTERÉS PARA LOS QUE DESEEN ESTUDIAR
INGENIERÍA ELÉCTRICA y MECÁNICA

Los jóvenes que deseen estudiar ingeniería eléctrica y mecánica harán bien en leer la lista de Universidades, Escuelas, etc., que insertamos a continuación. Estos Establecimientos gozan de excelente reputación por su seriedad y por la competencia de su personal docente, que comprende especialistas de fama universal. Ellos han contribuído notablemente al progreso de la Gran Bretaña y están ayudando eficazmente a muchas repúblicas latinoamericanas a explotar sus riquezas naturales.

El diploma de esos Institutos es garantía de una educación perfecta y tiene gran valor dondequiera que se presente.

Si quiere Ud. más informes sobre los cursos que anunciamos, escriba al Secretario de B.E.A.M.A., 36, Kingsway, Londres, Inglaterra, quien se complacerá en suministrárselos gratis.

DE INTERESSE AOS QUE DESEJAREM ESTUDAR A
ENGENHERIA ELECTRICA E MECHANICA

Os jovens que desejarem estudar a Engenheria electrica e a Mechanica, achariam de proveito ler a lista de Universidades, Escolas, etc que abaixo inserimos. Estes Establecimentos gozam de uma excellente reputação pela sua seriedade e competencia do seu pessoal de instrucção que inclue Especialistas de fama mundial. Elles tem contribuido notavelmente ao progresso da Gran Bretanha e estão ajudando a muitas Republicas latino-americanas a explorar as suas riquezas naturaes.

O Diploma dado por um destes Institutos constitue uma garantia de uma educação perfeita e goza de alta consideração em todo lugar em que fôr apresentado.

Desejando mais informações sobre os cursos que annunciamos, escrevam ao Secretario do B.E.A.M.A., 36, Kingsway, Londres, Inglaterra, que terão o maior prazer em fornecel-as gratis.

UNIVERSIDADES, ESCOLAS, INSTITUTOS TECHNICOS, etc., QUE DÀO UMA INSTRUCÇÀO COMPLETA EM ENGENHERIA ELECTRICA E MECHANICA (VEJAM-SE A SEGUINTE PAGINA.)

BRITISH v. GERMAN ELECTRICAL MACHINERY

A STRIKING COMPARISON

British-made machinery has established for itself all over the world an unsurpassed reputation for efficiency and reliability.

The following record speaks for itself, the facts being taken from the report of the Municipal Electrical Engineer to the Shanghai Municipal Council, Mr. T. H. U. Aldridge.

The Electrical Generating Station at Shanghai was originally equipped with British-made machinery, some of which has now been running satisfactorily for a period of over nine years.

The British machinery consists of steam turbo-alternators ranging from 500 to 1000 K.W. capacity.

About two years ago German turbo-alternators manufactured by the A.E.G. of Berlin were installed, having capacities of 2000 and 5000 K.W. respectively.

Serious defects developed in the German machinery very soon after it was set to work, resulting in about 66% of the turbine plant being out of action at a critical period.

The breakdown of the German plant was due both to mechanical defects in the turbines, owing to unsuitable metal having been used for the blading, and to electrical defects in the alternators and transformers, necessitating partial reconstruction.

One of the 5000 K.W. turbines stripped the blading of one wheel and is still (at the time of writing) running in this defective condition, taking over 50% more steam per horse-power per hour than was guaranteed by its German makers.

The following figures, calculated from the data given by the Municipal Engineer, show that the annual cost of maintenance and repairs for the German turbines was enormously in excess of that of the British-made machines :—

Make.	Capacity in Kilowatts.	Years in Use.	Comparative annual cost of repairs and Maintenance.	Approximate Cost in £
British No. 1	600	8	10	17
,, No. 2	600	8	13	23
,, No. 3	500	5	24	43
,, No. 4	1,000	9	27	47
,, No. 5	1,000	8	28	49
,, No. 6	500	5	30	53
German A.E.G. No. 1 ..	2,000	1 year 9 months.	150	265
,, A.E.G. No. 2 ..	2,000	1 year 9 months.	180	320

It will be readily understood that if such serious breakdowns can occur in the highest class of machinery made in Germany, when running under the supervision of skilled engineers, the troubles and cost of running will be very much greater when such skilled attention is not available.

As a result of the foregoing experience with British and German Electrical Machinery, the Shanghai Municipal Council have recently ordered one 10,000 and one 5,000 K.W. British turbo-alternators.

It is false economy to buy a German machine because its first cost is lower than that of a British machine.

In the long run the German machine costs more.

Printed for the Proprietors by PERCY LUND, HUMPHRIES & Co., LTD., The Country Press, Bradford and 3, Amen Corner, London, E.C.

2608

A UNITED CONFERENCE

"We have had meetings of EMPLOYERS' FEDERATIONS, of TRADE ASSOCIATIONS; we have had UNITED BRITISH INDUSTRIES' ASSEMBLIES and TRADE UNIONS' CONGRESSES. The time has now come to hold a UNITED CONFERENCE OF INDUSTRIES, bringing together Trade Associations, Labour Organizations, Scientific and Educational Institutions, Financial Associations, etc.

"The object should be to consider their reciprocal relations, their obligations to Society and methods by which they may co-operate in the interest of the Nation and the Empire.

"A gathering of this kind should out-rival in importance the meetings of *The British Association*, which is more or less academic and aloof from actual conditions.

"No doubt some enterprising Association will initiate such a conference to formulate a working policy for Industry that will overcome difficulties bound to arise if each separate interest is acting independently and without mutual conference and consideration.

"This conference, to be of value to the British Empire, should have representatives from the different over-seas Dominions, as the local problems in every part of the Empire are interdependent. There has never been such an opportunity as the present for a co-ordinated effort to raise the whole status of Industry."

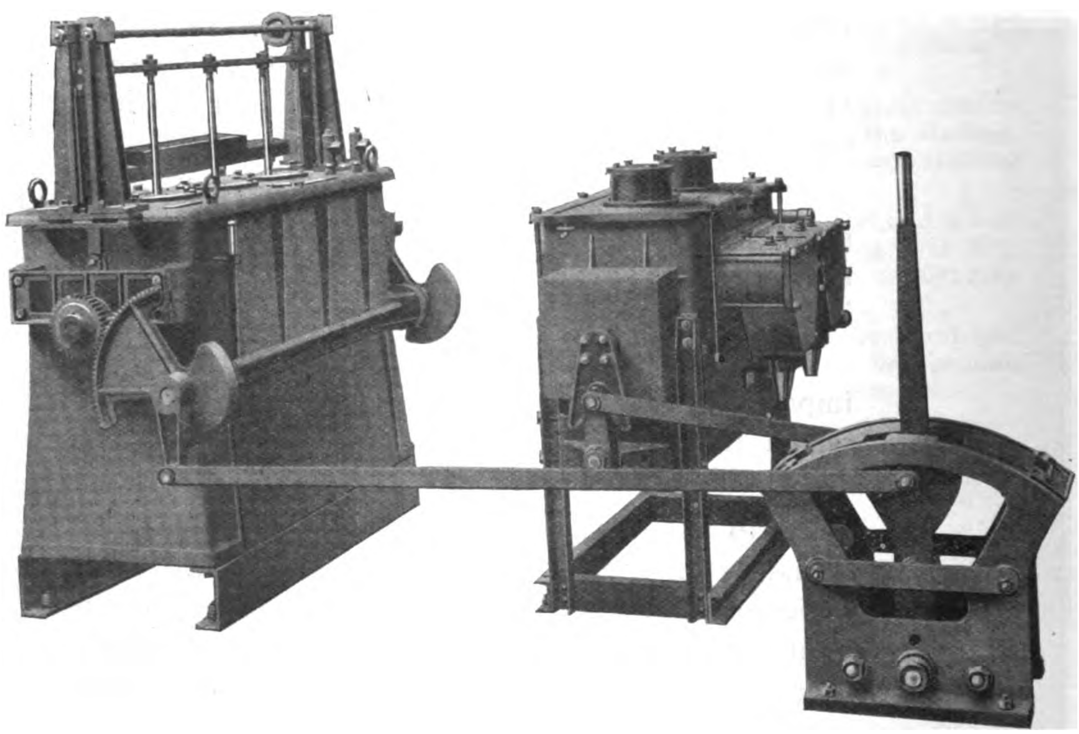
ALLEN WEST & CO., LTD.

BRIGHTON

Telegrams:
Control, Brighton.

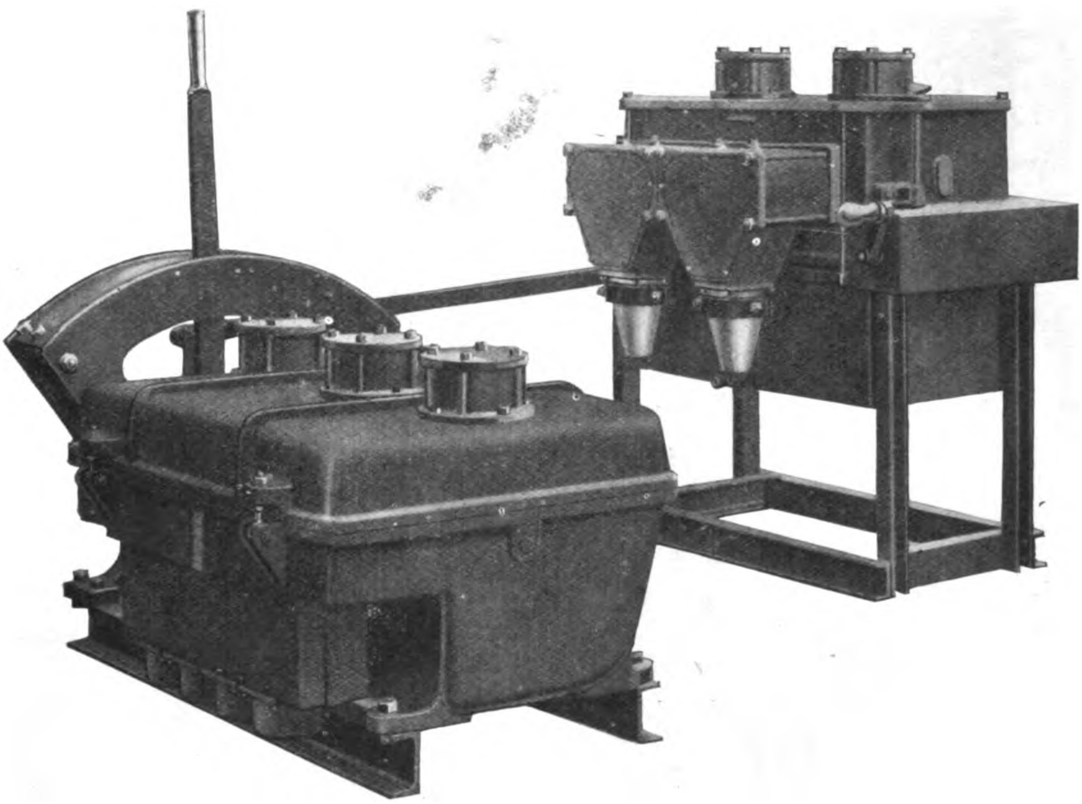
Code:
A.B.C., 5th Edition.

ELECTRIC CONTROLLERS

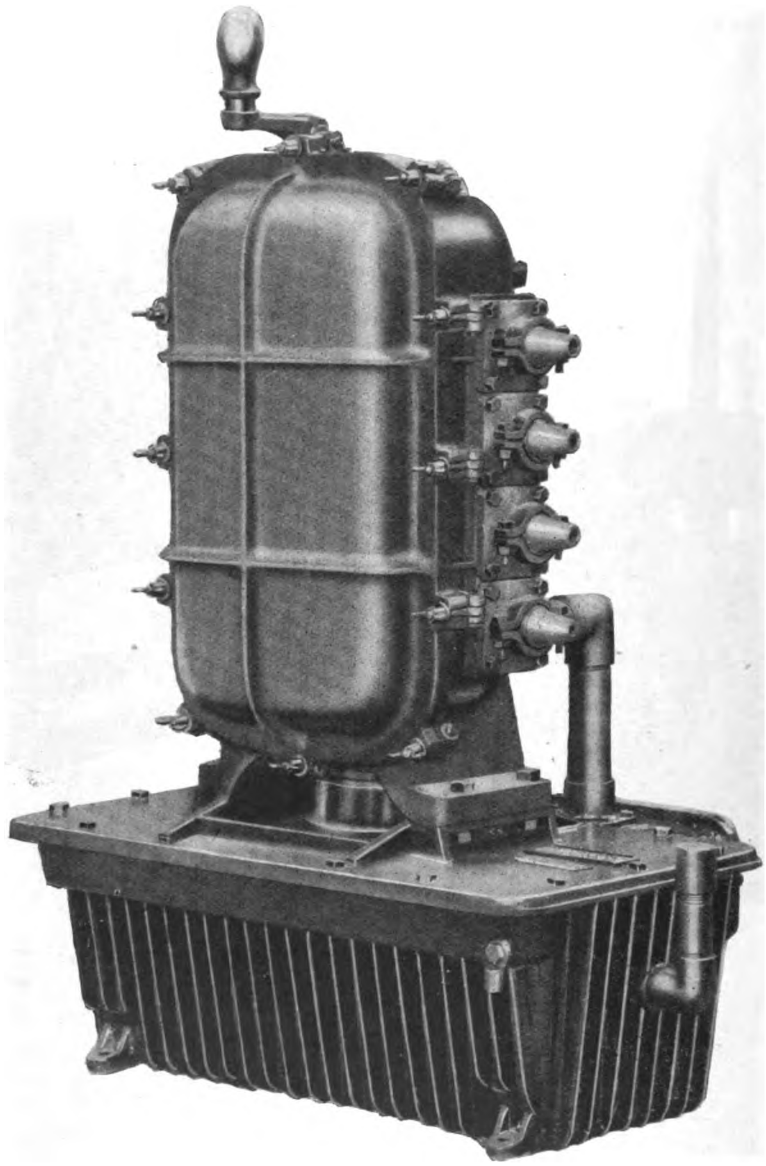


Liquid Controller with quick make and break Reversing Stator Switch and Lever Operating Gear, for the control of Haulages, etc.

ELECTRIC CONTROLLERS

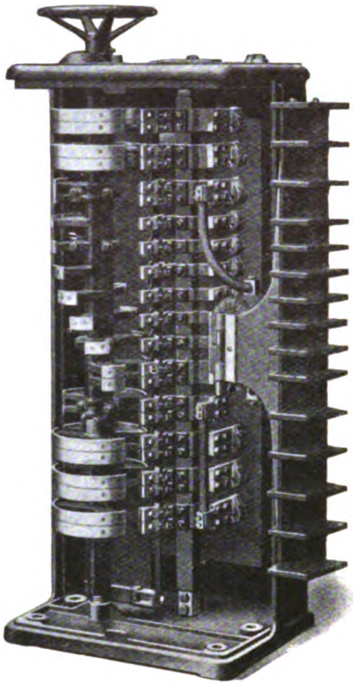


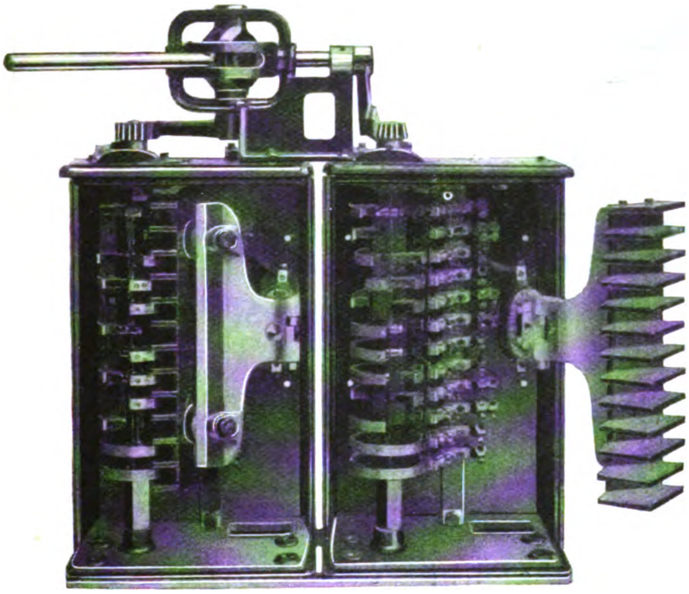
Another type of Haulage Controller
(oil immersed).



Flame-Proof Controller and Oil Immersed Resistance.

The two Controllers illustrated on this paper are examples of Drum Type Controllers, by Allen West & Co. In common with all other types, the chief feature is their sound mechanical design. The fingers used on these Controllers are a good example of this, as they consist of a gun-metal casting of great mechanical strength, pivoted on a solid bearing on the finger base, and pressed against the drum of the Controller by a spiral spring of tested pressure.





These fingers have been adopted by the British Admiralty, as the standard for the British Navy.

Controllers of every type for Crane, Winch, Mining Haulage and other services are standardised and stocked in large quantities.

The factory is solely devoted to the manufacture of Controllers.

READERS of these pages will find a condensed and ready reference to all classes of Electrical and Steam Machinery and Accessories in THE CLASSIFIED DIRECTORY OF MANUFACTURES, at the back of this Journal. The names and addresses of the firms are given in the Index at the end. Write direct to the firms for prices and further information.

A FULL STOP

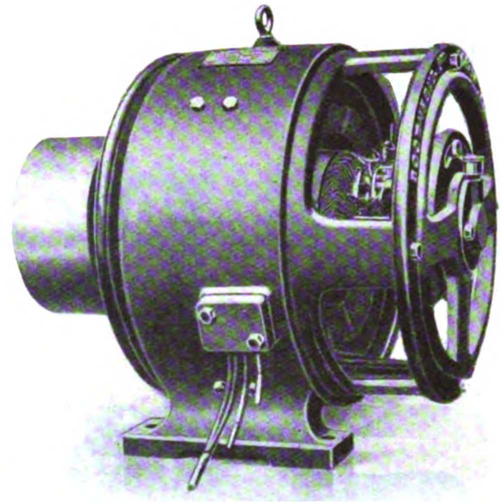
NOW THAT YOUR ATTENTION IS

ARRESTED

Write at once for Prices and Particulars of

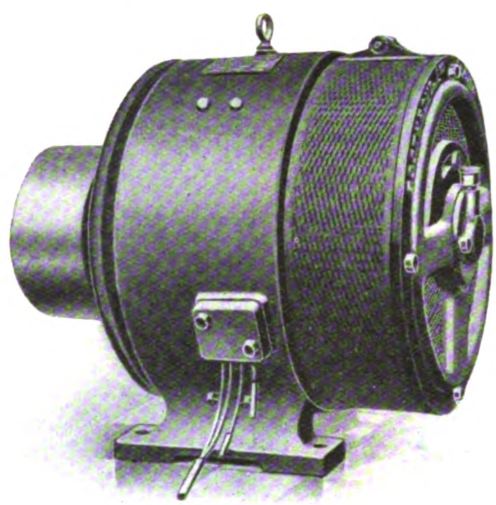
BOOTHROYD

DYNAMOS & MOTORS.



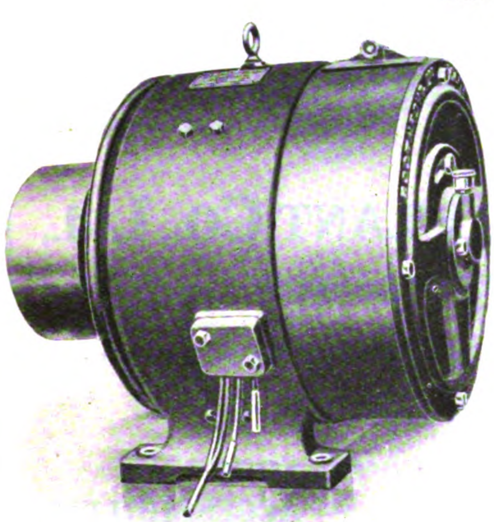
Open Protected Type.

UP-TO-DATE DESIGN EMBODYING ALL LATEST IMPROVEMENTS.



Enclosed Ventilated Type.

ILLUSTRATIONS OF OUR "B" TYPE MACHINES FITTED WITH ROLLER AND BALL BEARINGS.



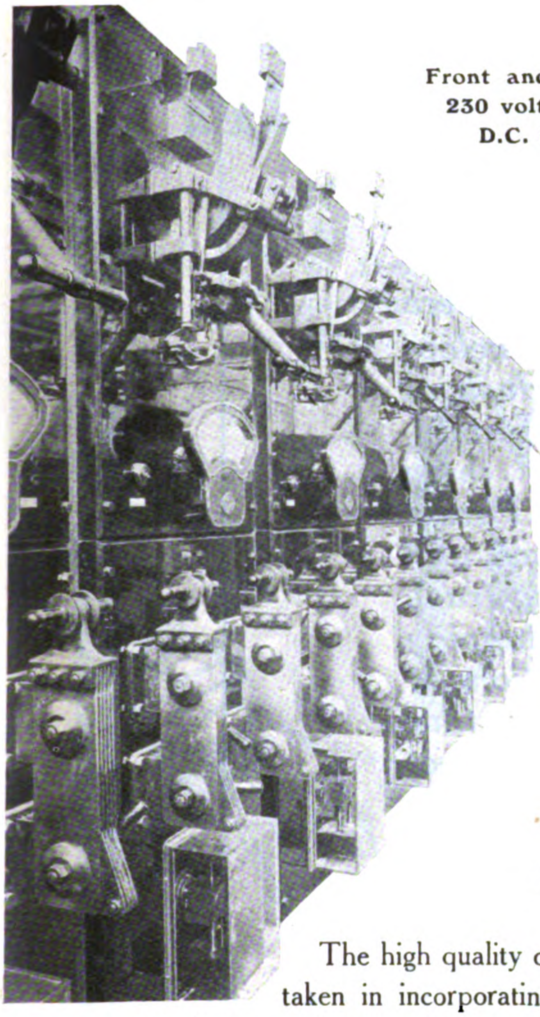
Totally Enclosed Type.

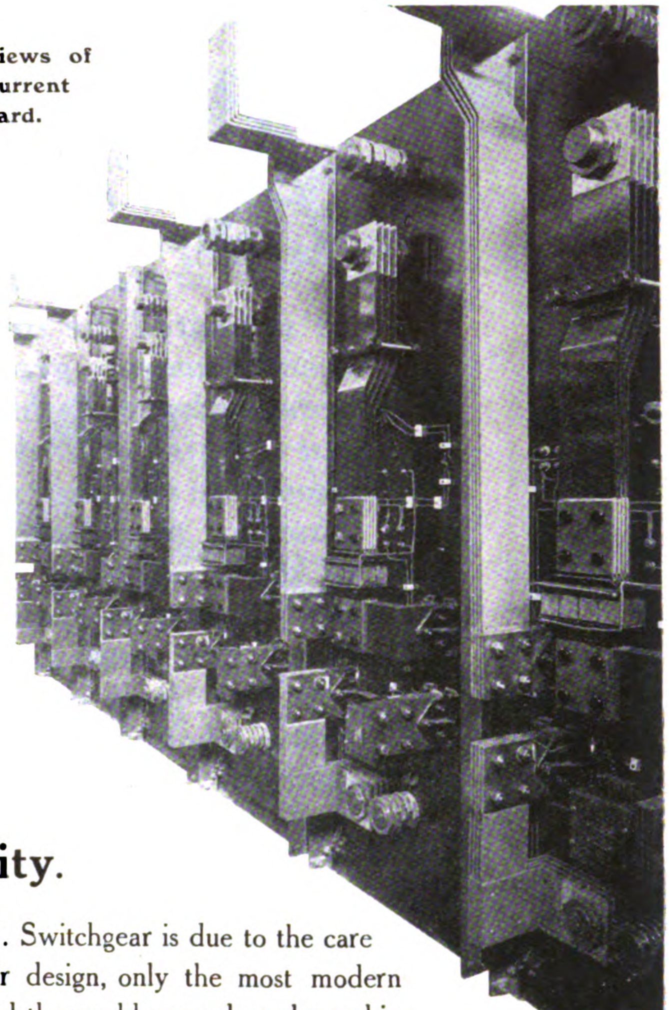
H. T. BOOTHROYD, LTD.,

BOOTLE, - LIVERPOOL.

Telegrams: "COMMUTATOR, LIVERPOOL."
Telephone: 420 BOOTLE.

The Electrical Hall Mark—for Quality. → B T-H





Front and **back** views of
230 volt **heavy** current
D.C. **Switchboard.**

Quality.

The high quality of B.T.H. Switchgear is due to the care taken in incorporating in their design, only the most modern practice, and in their manufacture, the best material and thoroughly sound workmanship.

Amongst the places abroad where important B.T.H. Switchboards have been supplied are the following :—

Calcutta, Bombay, Simla, Delhi, Rangoon, Zanzibar, Colombo, Shanghai, Hong Kong, Tientsin, Kyushu, Wakayama, Capetown, East Rand, Melbourne, Sydney, Gibraltar, Tharsis (Spain), Rheims (France), Venezuela.

Houston Company Ltd.

nd Manufacturers

Branch Works:
London and Coventry

Foreign Representatives:

INDIA.—The British Thomson-Houston Co., Ltd., Calcutta; Turner, Hoare & Co., Bombay.

JAPAN.—The British Thomson-Houston Co., Ltd., Yokohama; Bagnall & Hilles, Yokohama; Mitsui & Co., Tokyo and Osaka.

MEXICO.—The Mexican General Electric Co., Mexico.

NEW ZEALAND.—The National Electrical and Engineering Co., Ltd., Auckland, Christchurch and Wellington.

SOUTH AFRICA.—The South African General Electric Co., Johannesburg and Capetown; Johnson & Fletcher, Bulawayo and Salisbury.

The Electrical Hall Mark—for Quality. → B T-H

"ANY Imperial Conference would have to consider a large programme of important subjects. Not only must there be indicated the lines of development towards greater industrial independence within the Empire, but it is desirable that there should be unification of the Patent Laws, of the Company Laws, and of all regulations regarding trade and industry, including shipping conditions and the abolition of rebates. It is desirable, too, that there should be a more direct contract between the producer and the purchaser, without the intervention of the middleman to the great extent now prevalent; because there would be then a greater certainty that the goods supplied had their origin within the Empire."

—*The Man Power of the Nation*

The British Westinghouse Electric and Manufacturing Company, Limited.

To Iron and Steel Makers

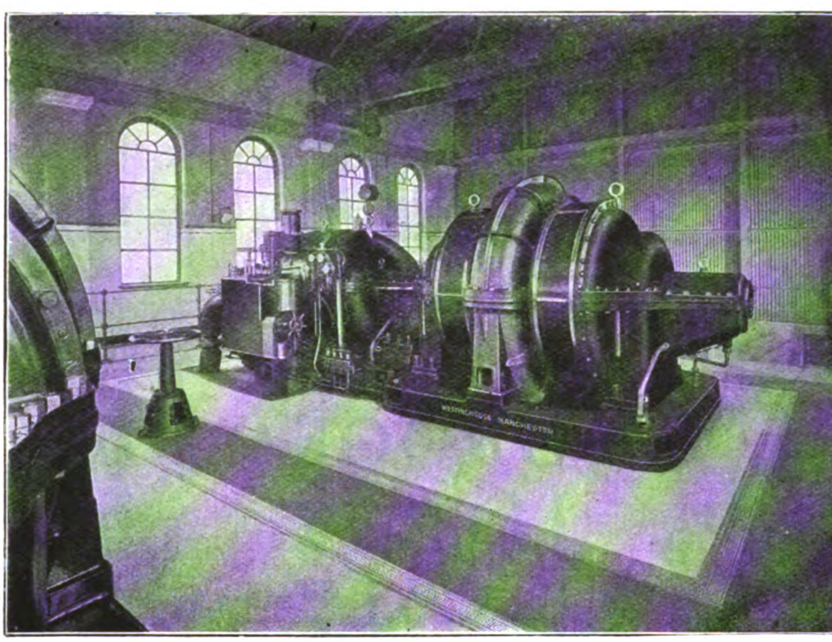
The British Westinghouse Company are prepared to supply

TURBO-BLOWERS

For Cupolas, Blast Furnaces, etc.

CONVERT WASTE
STEAM INTO ENERGY

Write Turbine Department



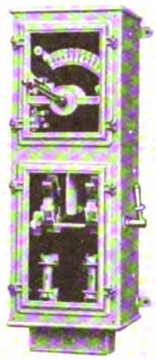
Installation of Turbo-Blower Unit, 25,000 cubic feet per minute at 6 lbs. per square inch gauge pressure.

Westinghouse
Manchester

Trafford Park **Manchester**

BROOKHIRST SWITCHGEAR

FOR CONTINUOUS CURRENT MOTORS



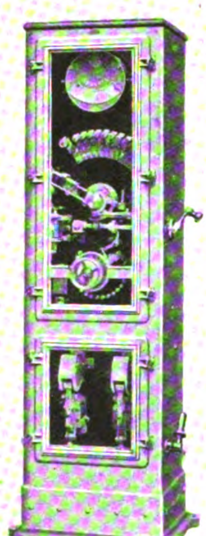
2 BW

12 BW

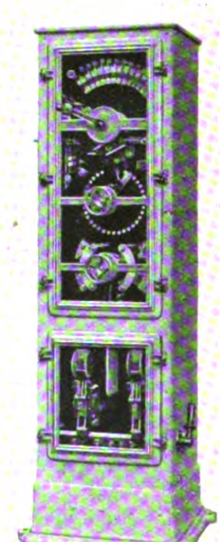
ML 13

CS 2

BS 2



13 CP

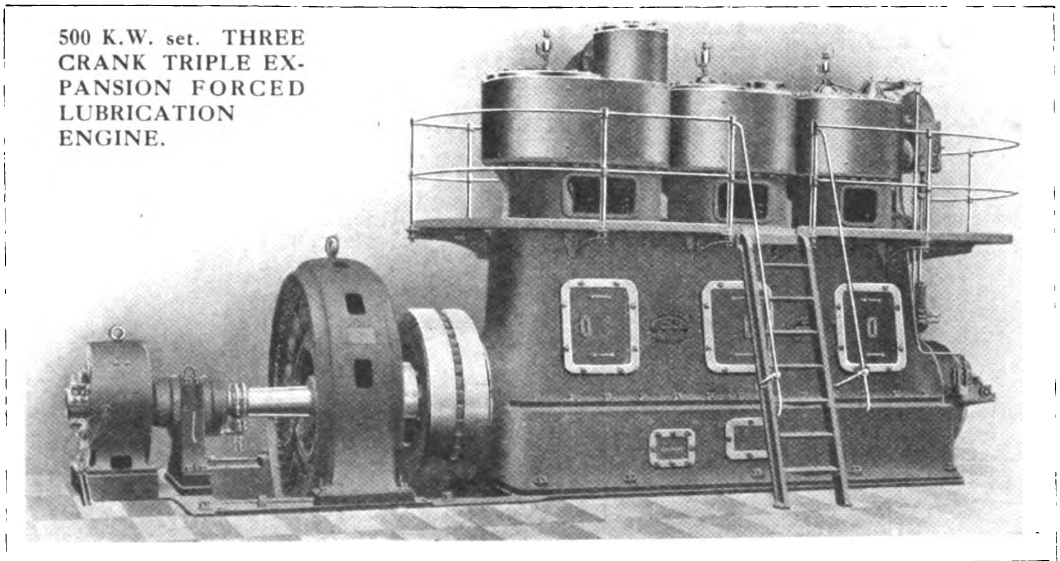


12 BP/R

BROOK
HIRST
& Co. Ltd
Northgate
Electrical Works
CHESTER

Representative selection of BROOKHIRST Motor Controlling Switchgear

For Prices and Full Particulars see Catalogue No. 3



500 K.W. set. THREE CRANK TRIPLE EXPANSION FORCED LUBRICATION ENGINE.

ARE YOU INTERESTED
IN VERTICAL STEAM OR GAS DRIVEN POWER PLANTS ?

BROWETT-LINDLEY engines are as simple as can be manufactured to give great economy combined with high efficiency.

¶ This result has only been obtained by careful design and the best possible workmanship.

¶ The advantages of these engines have long been recognised by Owners of Collieries, Ironworks and other Industrial undertakings for generating power with minimum amount of attention.

¶ They are particularly suitable where long non-stop runs are required, such as for Power Stations and Paper Mills, a great number being in operation under these conditions.

¶ Ask us to mail you our Pamphlets and Illustrated Catalogue.

Browett-Lindley

& CO., LTD.,

PATRICROFT, MANCHESTER

and

Amberley House, Norfolk Street, Strand, LONDON, W.C.

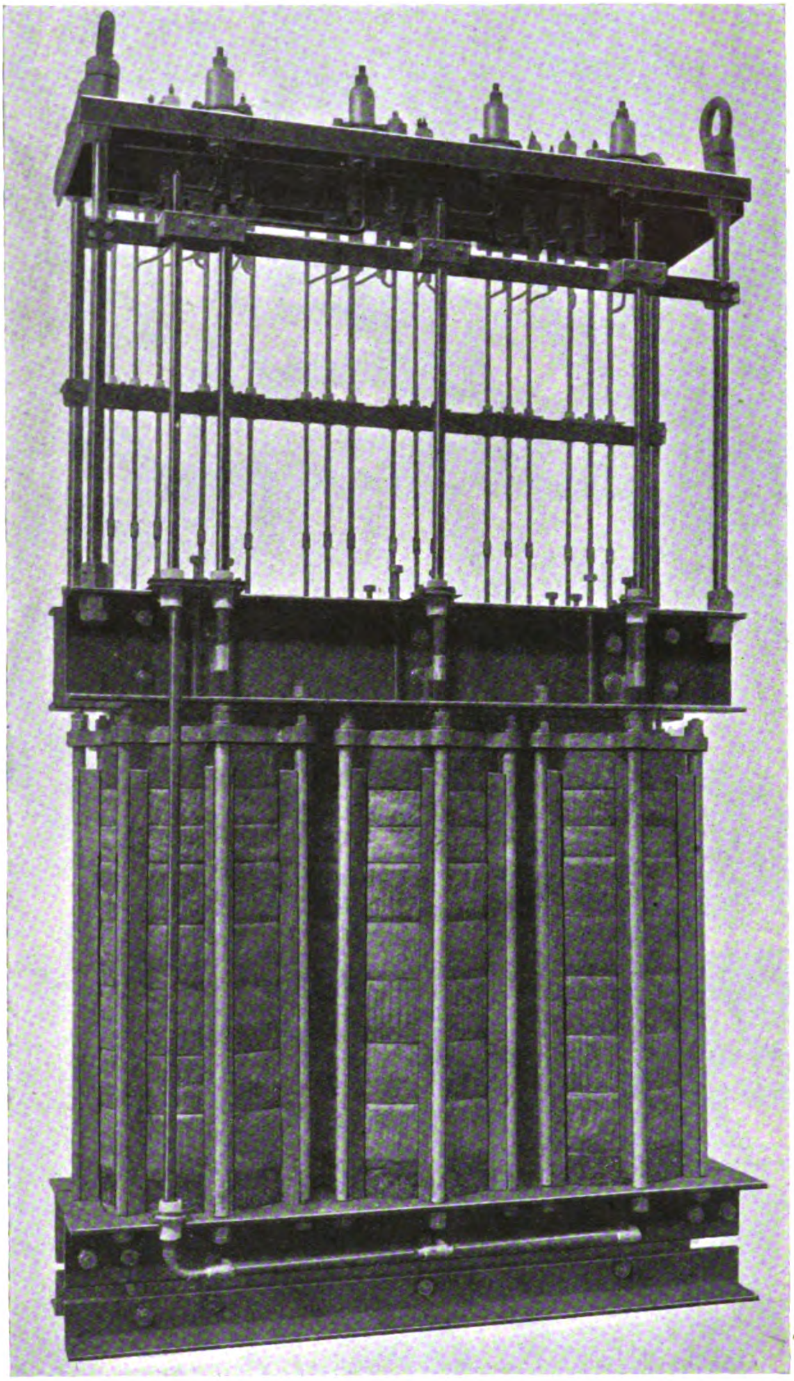
AGENTS—

ARGENTINE REPUBLIC: Agar, Cross & Co., Ltd., Buenos Ayres.
SOUTH AFRICA: Hubert Davies & Co., Johannesburg, Durban, etc.
SPAIN: Ricardo Zaragoza, Barcelona.
JAPAN: L. J. Healing & Co., Ltd., Yokohama and Kobe.
AUSTRALIA; Simpson Bros., Lawson House, 49, Clarence Street, Sydney.
NEW ZEALAND: J. Chambers & Son, Ltd, Auckland, Wellington.
NORWAY; Aktieselskabet Lorentzen & Wettre, Kristiania.
FINLAND: Aktiebolaget Ekstroms Maskinoffar Osakeyhtio, Helsingfors.

1200 K.V.A.

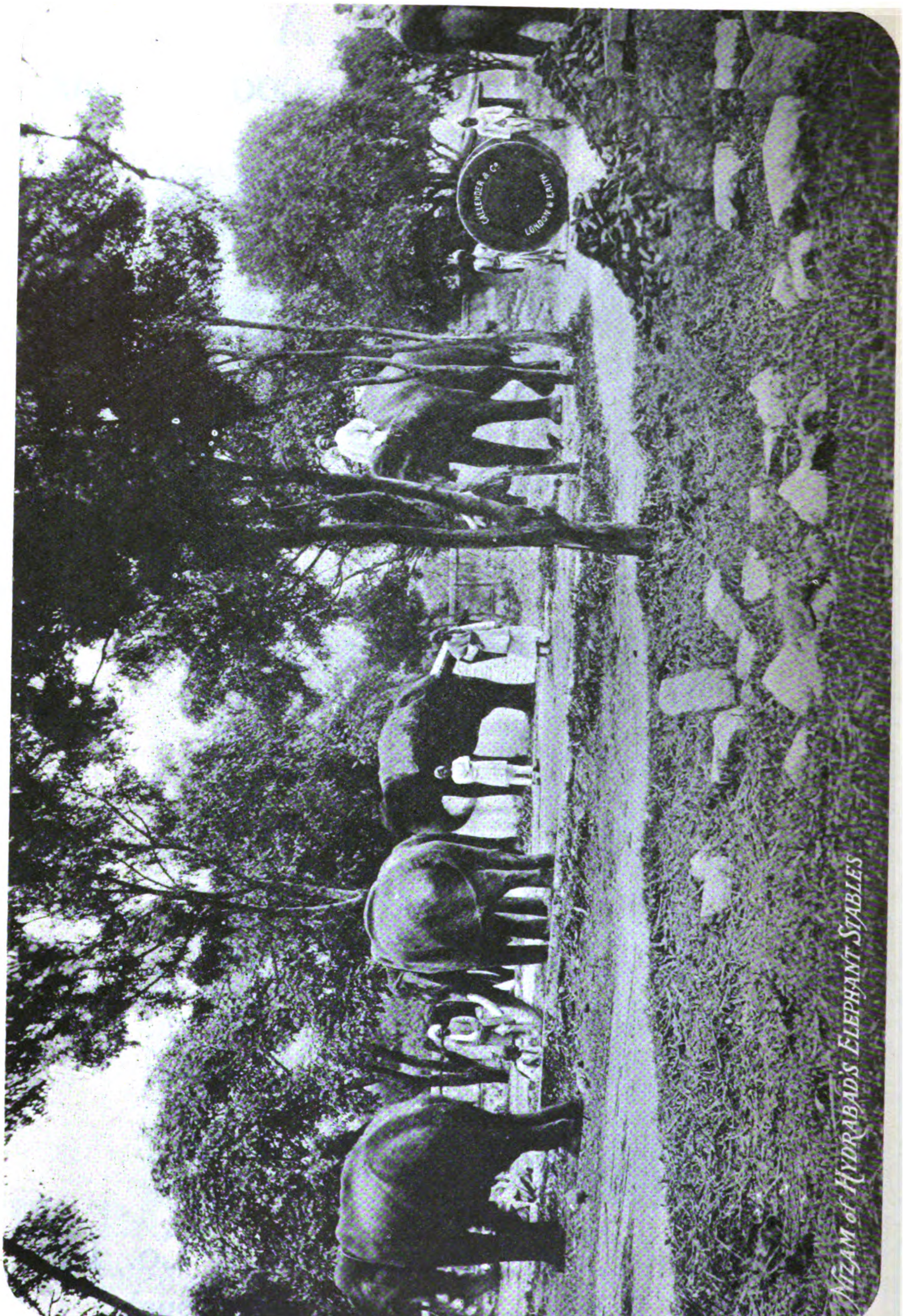
Transformer 50 periods. $12000/\begin{smallmatrix}2600\\2750\\2900\end{smallmatrix}$ volts.

With Clamped Coils.



The Brush Electrical Engineering Co., Ltd.

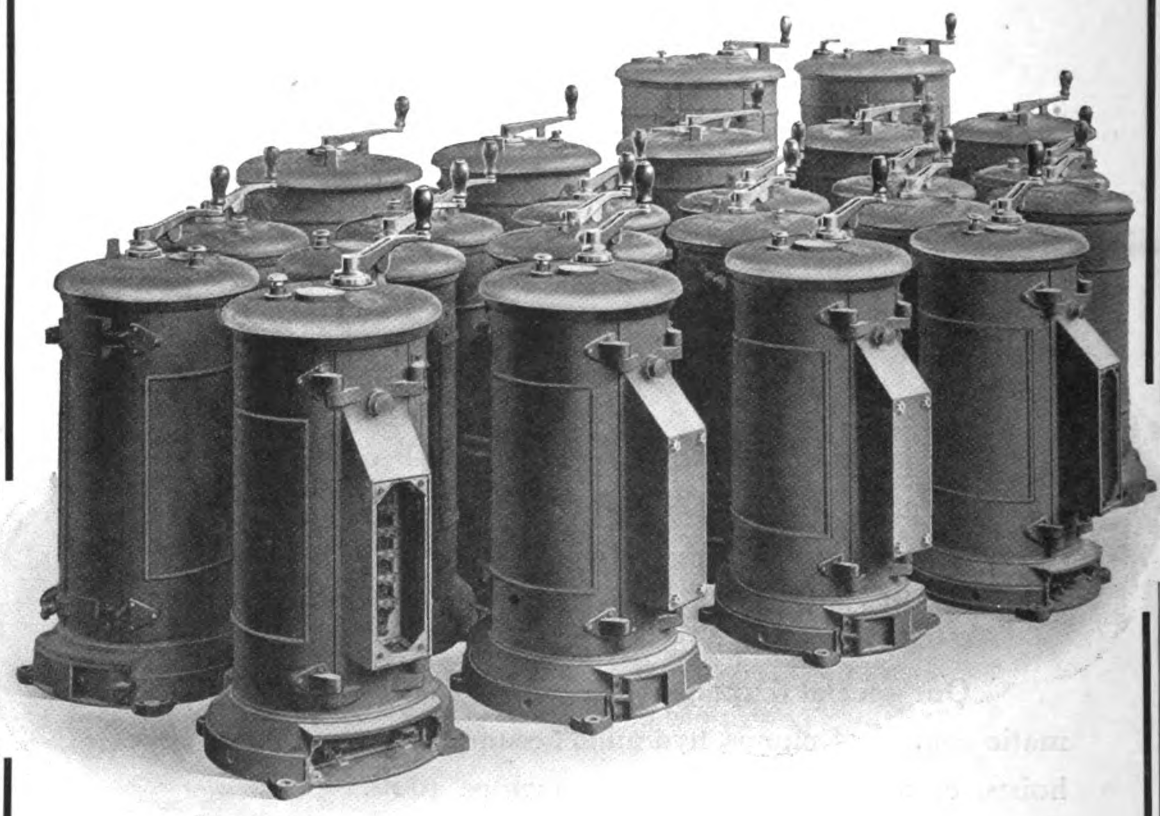
Falcon Works: - - Loughborough.
London Office: No. 1, Kingsway, W.C.



Nizam of Hydrabad's Elephant Stables

VICKERS CONTROL PILLARS

For controlling motors driving all classes of machinery subjected to frequent starting and stopping operations.



THE ELECTRIC & ORDNANCE ACCESSORIES COMPANY LIMITED.

WARD END WORKS, BIRMINGHAM.

Telephone : 960 East.

Telegrams : "Vickers, Birmingham."

AGENTS :

LONDON : Electrical Department, Vickers House, Broadway, Westminster, S.W.

MANCHESTER : R. Foster, 196, Deansgate.

GLASGOW : J. & A. Anderson, 231, St. Vincent Street.

SHEFFIELD : H. E. Ridley, 19, Vainor Road.

AGENTS :

NOTTINGHAM : F. Mansfield, 197, Station Road, Beeston, Notts.

SWANSEA : W. Ogden Dayson, 1, Mount Street.

YORKSHIRE & THE TEES : F. MacCallum, Austhorpe Road, Crossgates, Leeds.

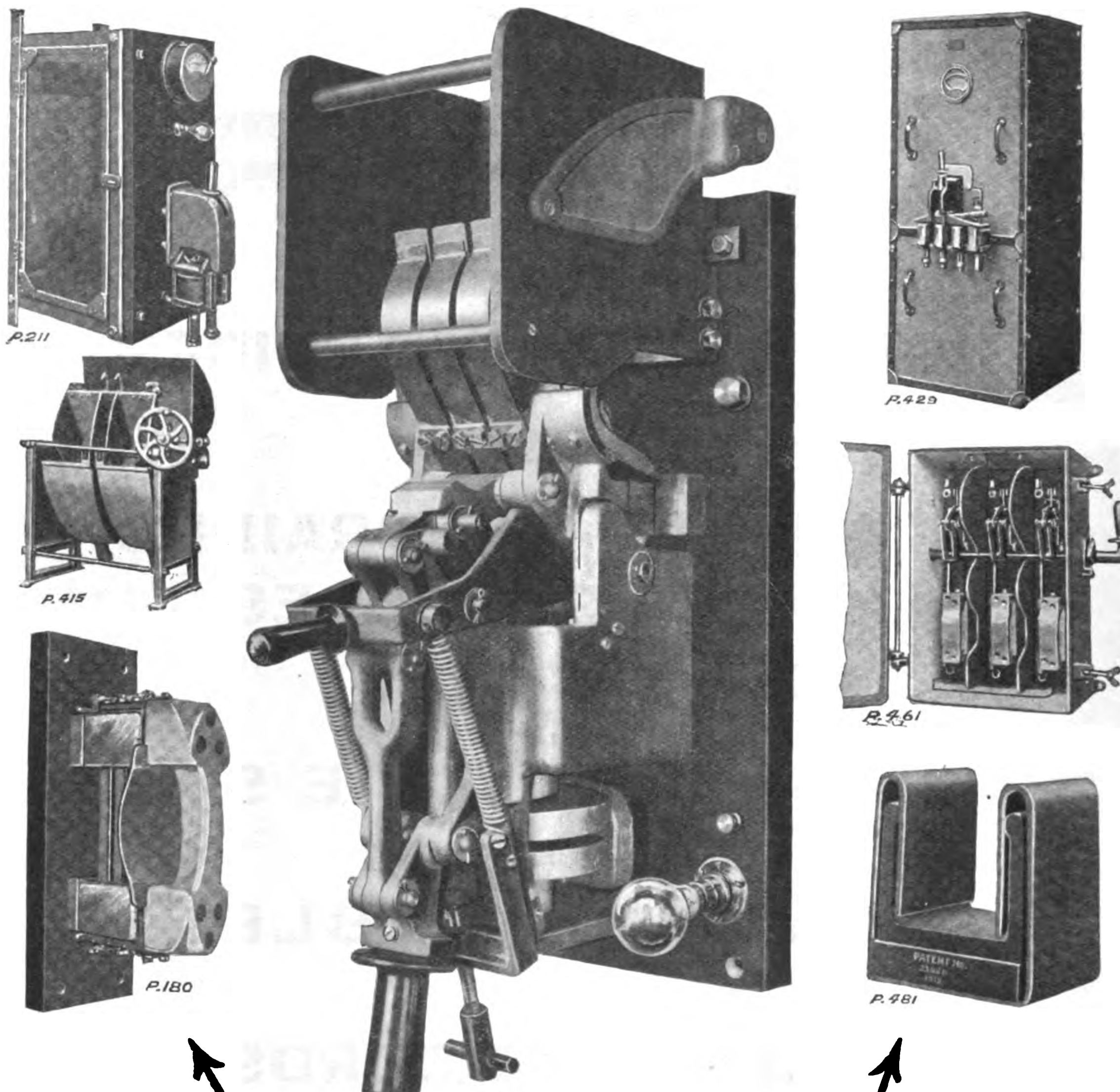
MIDLANDS : Bill & Berry, 39, Great Charles Street, Birmingham.

NEWCASTLE-ON-TYNE : T. J. Grainger & Co., Edinburgh Life Buildings, 21, Mosley Street.

MANUFACTURERS OF ALL KINDS OF SWITCHBOARDS AND

A.C. & D.C. SWITCHGEAR

Contractors to ADMIRALTY, WAR OFFICE, INDIA OFFICE, PRINCIPAL RAILWAY COMPANIES, - COLLIERIES, Etc.



ALL OUR FUSES are now fitted with OUR PATENT REINFORCEMENT, which prevents the jaw being bent out of shape, and further, even should the jaw become softened, this reinforcement gives the necessary pressure to make PERFECT electrical CONTACT under ALL CONDITIONS.

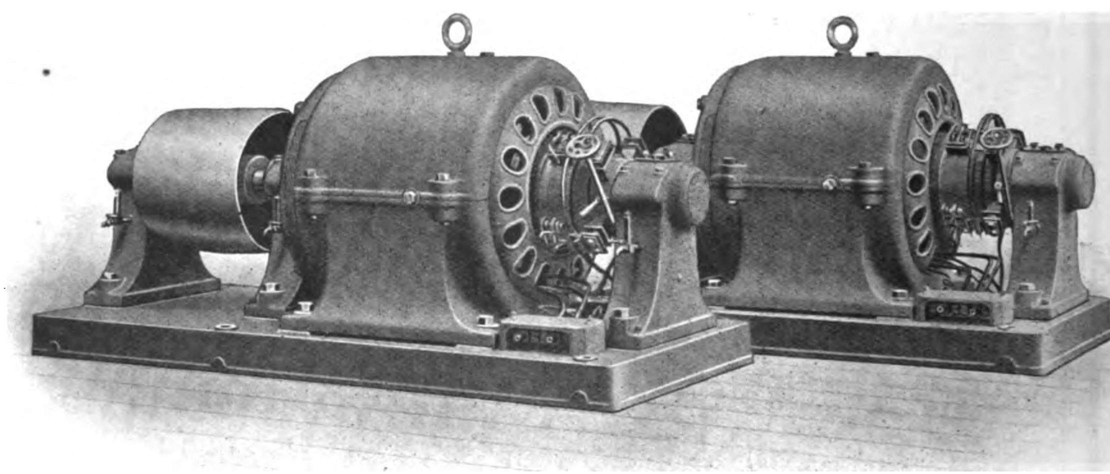
ERSKINE, HEAP & Co., Ltd.

Lancashire Switchgear Works,

BROUGHTON, MANCHESTER.

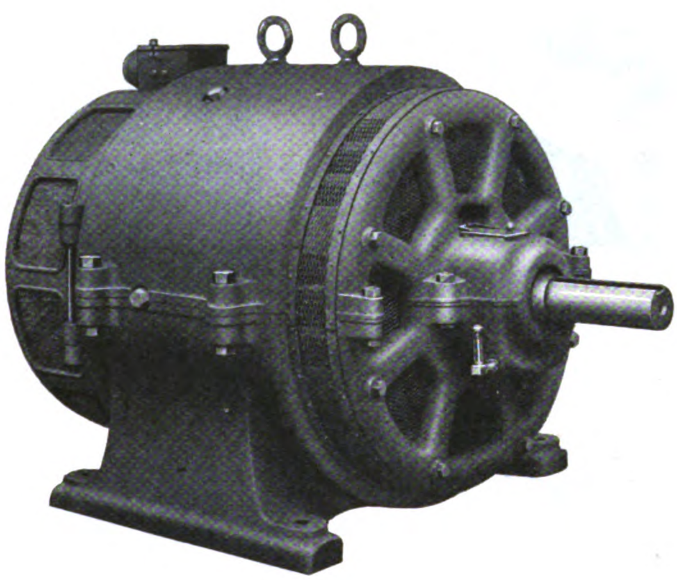
Breakdowns of German Plant

On June 18th, 1916, one of the 5,000 K.W. German alternators, in the Shanghai Municipal Electricity Works, which was commissioned only last year, broke down very badly. Some of the stator coils either short-circuited or went to earth, causing a very bad burn-out in part of the stator to such an extent that the copper conductors and the iron laminations became entirely fused together, whilst the insulation of half the end windings was completely burnt off. To repair this machine will take at least three months, and even then it is doubtful whether it can be regarded as a reliable piece of apparatus. Of the four A.E.C. turbo-generator sets at Riverside three have already seriously broken down. This sort of thing will damage the reputation of German manufactures very seriously in the Far East.



1 to 100 B.H.P.

Free from commutation troubles
Accessible
Small in weight and space
Stocks available in France, Australia, India, New Zealand and Argentine.



NATAL. A. B. Jones, Ltd., Durban.
ARGENTINE. Angel Muzzio é Hijos, Rosario.
HOLLAND. G. W. E. Gibson, 55 Stadhoudersplein, The Hague.
GREECE. J. McD. Barbour, Vulcan Works, Piræus.
MADEIRA. Raleigh C. Payne, Caixa, No. 17.
RUSSIA. A. V. Frank, Dobra Slobodka No. 12, Moscow.
FRANCE. Compagnie Française des Moteurs à Gaz "National" 138, Boulevard Richard-Lenoir, Paris.
ITALY. G. M. Carrera, Corso Venezia 63, Milano.

"Magnet," Manchester. 7094 Central.
"Orders," Cannon, London. 5370 City.

Electromotors Limited

OPENSHAW:
Manchester, England.
London. 49 Queen Victoria Street, E.C.

EDISWAN HOSGOOD

STONEWARE COOKING UTENSILS

These clean, handsome Stoneware Utensils appeal to everybody—Quick in Action, Economical, Light in weight, and thoroughly satisfactory in every detail.

REASONABLY PRICED TO THE CONSUMER AND A SUBSTANTIAL PROFIT TO THE FACTOR AND RETAILER.

We invite inquiries from Factors and others for general selling schemes on a large scale. Showcards and over-printed literature are a special feature, and every help will be given regarding the general advertising of our customer's stock.

ONE CUSTOMER MAKES MANY—BY RECOMMENDATION.

FOOD WARMER.

SHAVING POT

BOILING JUG.

CASSEROLE.

Apply to

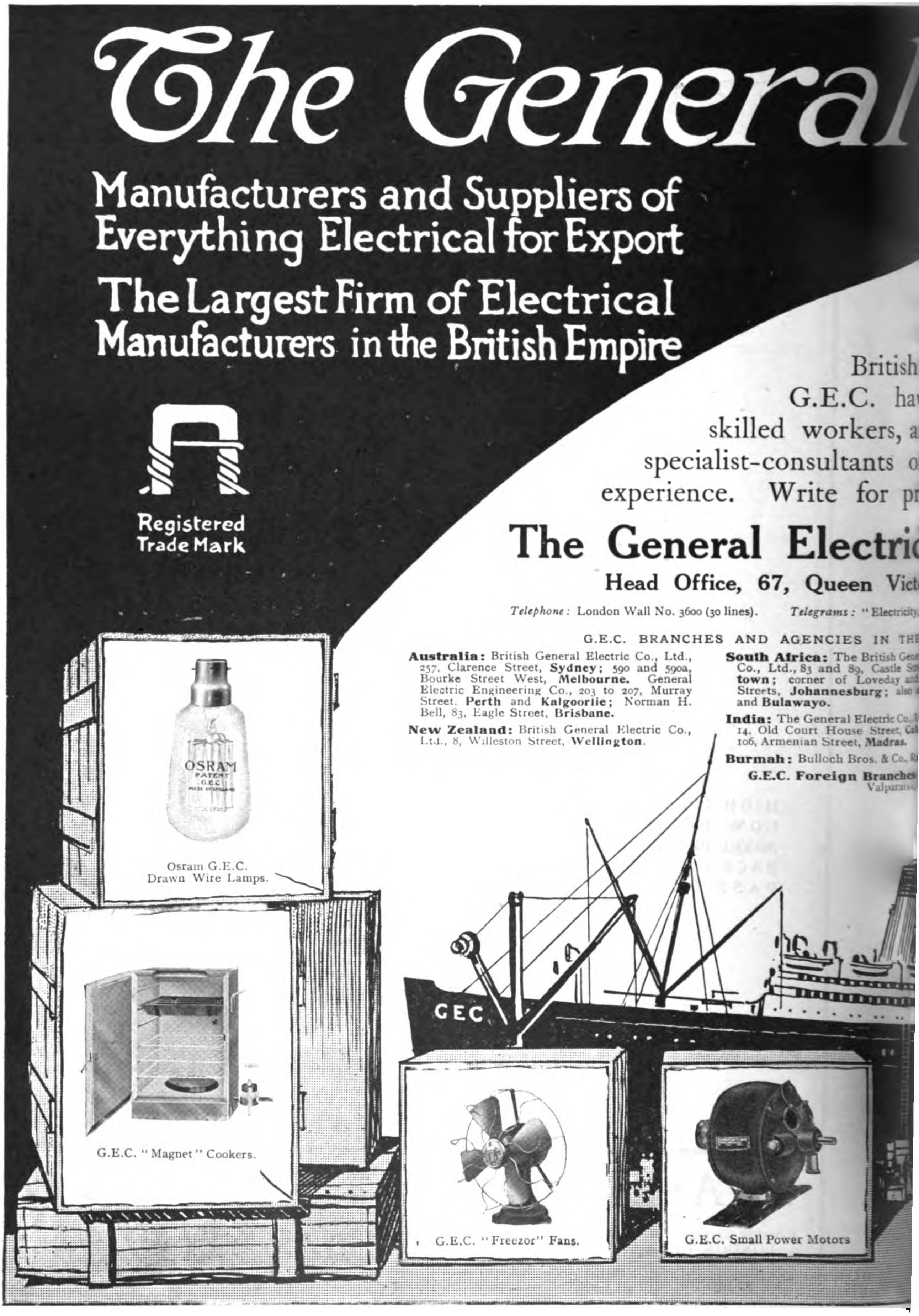
THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
PONDERS END, MIDDLESEX.

THE PRIMARY AIM OF INDUSTRIALISTS is to achieve:—

1. Continuity of employment for the workers;
2. Ensurance of a satisfactory rate of remuneration;
3. A reduction in the cost of output; and
4. The expansion of the purchasing market.

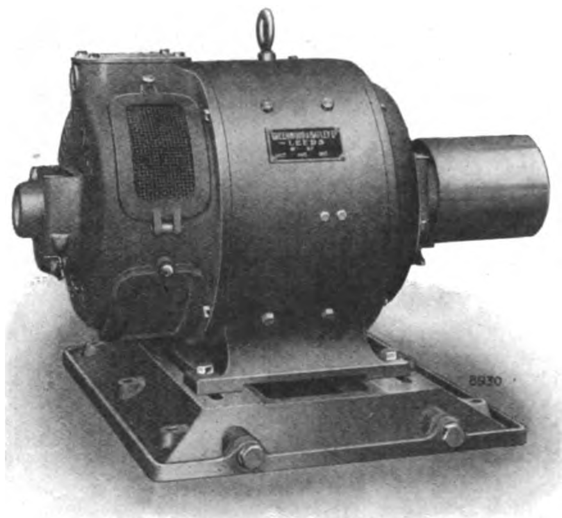
It follows that these aims being achieved, the prosperity of the working classes is promoted, because not only is the income of each unit made more constant and greater, but the purchasing power of the wage is augmented by reason of the cheapening of production.

—*"The Man Power of the Nation."*


The General
Manufacturers and Suppliers of Everything Electrical for Export
The Largest Firm of Electrical Manufacturers in the British Empire
Registered Trade Mark
British
G.E.C. ha
skilled workers, a
specialist-consultants o
experience. Write for p
The General Electri
Head Office, 67, Queen Vict
Telephone: London Wall No. 3600 (30 lines). Telegrams: "Electricity,
G.E.C. BRANCHES AND AGENCIES IN THE
Australia: British General Electric Co., Ltd., 257, Clarence Street, Sydney; 590 and 590a, Bourke Street West, Melbourne. General Electric Engineering Co., 203 to 207, Murray Street, Perth and Kalgoorlie; Norman H. Bell, 83, Eagle Street, Brisbane.
New Zealand: British General Electric Co., Ltd., 8, Willeston Street, Wellington.
South Africa: The British Gene Co., Ltd., 83 and 89, Castle St town; corner of Loveday an Streets, Johannesburg; also and Bulawayo.
India: The General Electric Co., 14, Old Court House Street, Ca 106, Armenian Street, Madras.
Burmah: Bulloch Bros. & Co., R
G.E.C. Foreign Branches
Valparaiso,
OSRAM
Osram G.E.C. Drawn Wire Lamps.
G.E.C. "Magnet" Cookers.
GEC
G.E.C. "Freezor" Fans.
G.E.C. Small Power Motors


Electric Co. Ltd.
Known throughout the World as the
G.E.C.
...very article featured
...is page is British made to
...rds of workmanship. The
... their factories the most
... their staffs scientists and
...ptional ability and wide
...ts and illustrated bulletins.
...mpany, Ltd.
...reet, London, E.C.
...on." Cablegrams: "Polyphase, London."
...H EMPIRE:
China: The General Electric Co. of China, Ltd., 2, Queen's Buildings, Hong Kong; 7, Jinkee Road, Shanghai: 4, Tung Ting Road, British Concession, Hankow.
West Indies: Barbadoes Electric Supply Corporation, Ltd., Bridgetown, Barbadoes.
Siam: The Bangkok Dock Co., Bangkok.
...cies: Paris, Amsterdam, Buenos Ayres.
...ncepcion, Lima, etc.
G.E.C. "Magnet" Electric Fires.
G.E.C. Wires.
G.E.C. "Magnet" Electric Irons.
G.E.C. Measuring Instruments.
G.E.C. "Magnet" Electric Kettles.
G.E.C
DRY BATT...
G.E.C. Dry Cells.
G.E.C. Toasters.
G.E.C. Telephones.
G.E.C. Starters.
G.E.C. Electrical Plant.
G.E.C. Cables.
Robertson Carbon Filament Lamps.
G.E.C. Fittings.
G.E.C. Arc Lamps.

ELECTRIC MOTORS



AND

GENERATORS

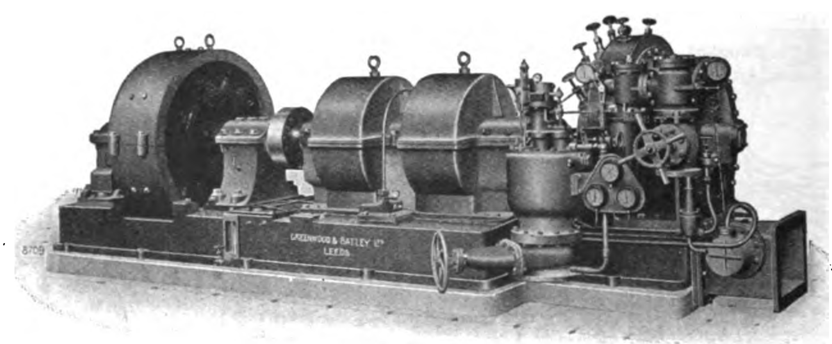
CONTINUOUS
AND
ALTERNATING
CURRENT

Standard Ventilated
Enclosed Type
Continuous Current Motor.

STEAM TURBINES

HIGH PRESSURE—MIXED PRESSURE—EXHAUST STEAM
FROM 3 B.H.P. TO 600 B.H.P.

450 H.P. Turbine-Dynamo, Mixed Pressure Type, for Utilising Waste Steam.



CONTRACTORS TO ADMIRALTY, WAR OFFICE, INDIA OFFICE, ETC., ETC.

Send for New Illustrated Catalogue.

GREENWOOD & BATLEY LTD
LEEDS

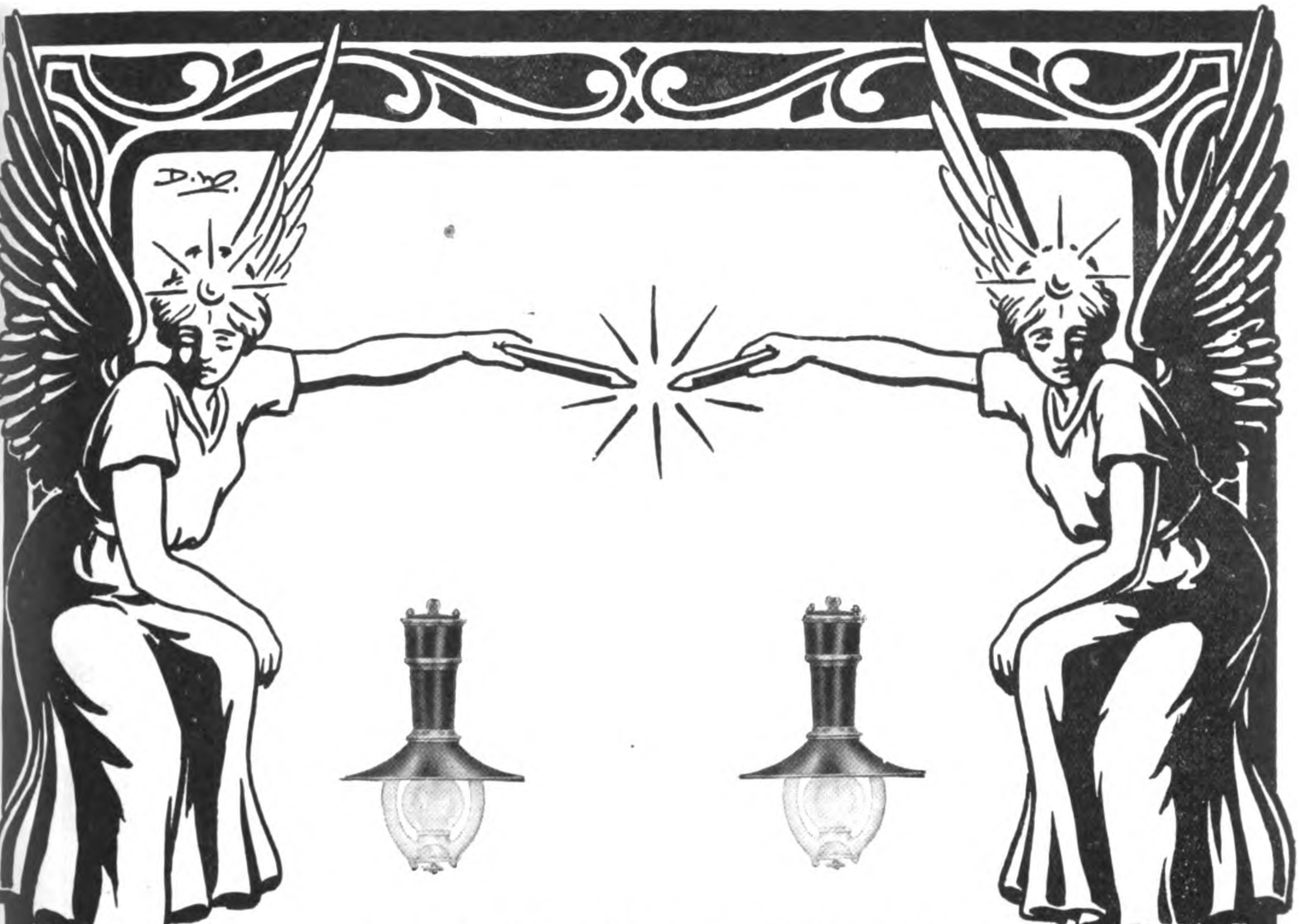
TELEPHONE:
5200 LEEDS.

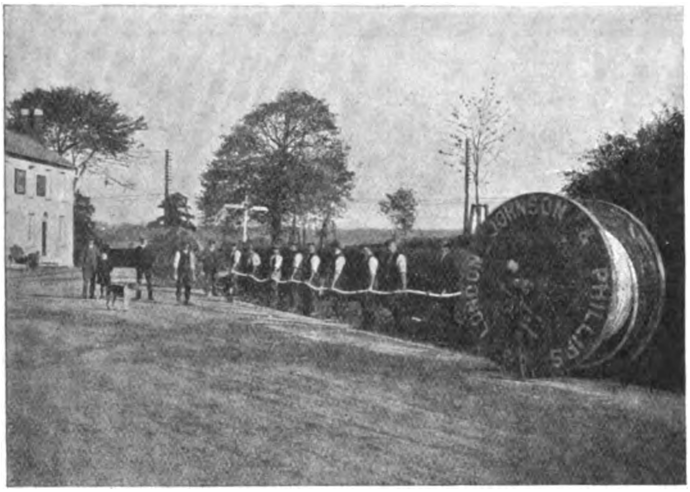
TELEGRAMS:
GREENWOOD, LEEDS.

"WITH the return to normal times the national necessity for war stores and munitions will cease, and our industrial forces will have to rely on the home and foreign markets for employment. Foreign competition will almost certainly be greatly intensified.

¶ If, under such circumstances, we indulge in an internal struggle between Capital and Labour, instead of bending our whole energies to retain and extend our hold on markets, we shall lose an opportunity which is not likely to return."

—PROFESSOR KIRKALDY, at the recent meeting of
THE BRITISH ASSOCIATION.


D.W.



Laying High-Tension Underground Cable at Weaverham, Cheshire.

CABLES

For Working Pressures up to 30,000 VOLTS.

V.I.R. Cables, Wires and Flexibles, Association and Non-Association Classes.
Paper-Insulated Lead-covered and Armoured Cables.
Vulcanised Bitumen Cables, to Mining Rules.
Telephone Cables—Dry Core, Armoured and Non-Armoured.
Trailing Cables—Cab Tyre Sheathed and Hard Cord Braided.
Aerial Cables, Fire and Acid-Resisting Cables, Signal and Shot-firing Cables, Bell Wires, etc., etc.

CONTRACTORS FOR COMPLETE LIGHTING AND POWER SCHEMES, UNDERGROUND AND OVERHEAD TRANSMISSION LINES, ETC.

DYNAMOS AND MOTORS

SWITCHGEAR for all purposes

TRANSFORMERS

INSTRUMENTS

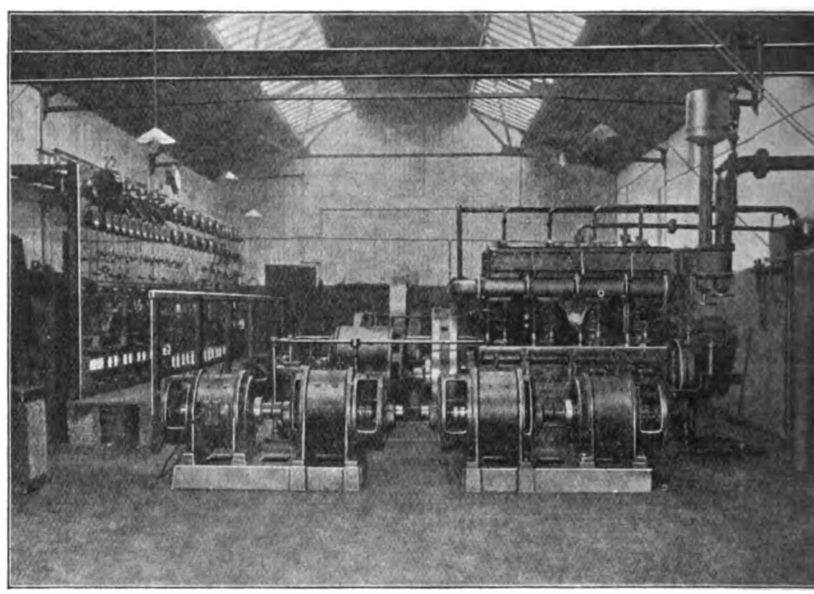
ARC LAMPS. The "Metro-flam" long-burning Flame Lamp is the cheapest high-power light.

SEARCHLIGHTS

INCANDESCENT LAMPS AND FITTINGS

LINE MATERIAL AND INSULATORS

EVERY ELECTRICAL REQUISITE



Vertical Gas Engine and Dynamo, Motor Alternators and Switchgear. Supplied and Erected by Johnson & Phillips, Limited.

Established 1875.

JOHNSON AND PHILLIPS LTD CHARLTON, LONDON, S.E.

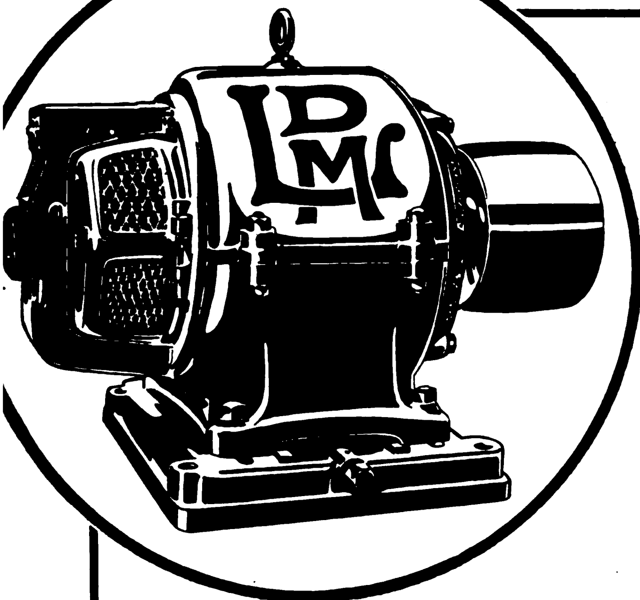
Cablegrams: "Juno, London."

CONTRACTORS TO BRITISH AND COLONIAL GOVERNMENTS.

Branch Offices and Stores:	Telephones:	Telegrams:
Birmingham—206, Corporation Street.	Central 7321	"Selbac."
Cardiff—9, Park Place.	Cardiff 1937	"Selbac."
Glasgow—159, West George Street.	Central 2391	"Megohm."
London, E.C.—12, Union Court, Old Broad St.	Central 2207	"Juno."
Manchester—251, Deansgate.	Central 4174	"Selbac."
Newcastle-on-Tyne—44b, Blackett Street.	Central 1691	"Selbac."
Portsmouth—Cleveland Road, Gosport.	Gosport 166 Portsmouth 1354	

Agents:—

SOUTH AFRICA.—R. H. Gould & Co., Basement, Trust Buildings, Johanne-burg.
NEW SOUTH WALES.—N. Guthridge, Ltd., Equitable Buildings, George St., Sydney.
NEW ZEALAND.—Tolley & Sons, Ltd. Chews Lane, Wellington.
INDIA.—Turner, Hoare & Co., Electrical Engineers, Bombay. Balmer, Lawrie and Co., Electrical Engineers, Calcutta.



Efficiency

in

British Motor Construction

"Lancashire" Dynamos and Motors have, as a result of years of extensive manufacture, acquired distinction amongst discriminating engineers, largely by reason of their

High and Constant Degree of Efficiency

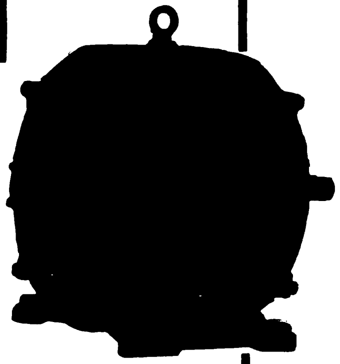
Powerfully built of the most carefully selected and tested materials by experienced British Workmen, all the products of the L D.M form, in themselves, most effective advertisements, by reason of the complete satisfaction they always give.

If your interest includes :—

Generators - Motors - Boosters
Balancers or Motor Generators

for any purpose, at home or abroad, we shall appreciate your enquiries, send you suitable lists and give all advice and assistance in our power.

LANCASHIRE DYNAMO & MOTOR CO. —— LTD.
TRAFFORD PARK — MANCHESTER



CONTRACTORS TO H.M. GOVERNMENT, WAR OFFICE, INDIA OFFICE, G.P.O., Etc.

Head Office Telephones: City 7450 (6 lines).
Telegrams and Cables: "Ironclad, Manchester."

AGENTS & FOREIGN OFFICES:

South Africa—Griffin Engineering Co., P.O. Box No. 2155 Johannesburg.
Australia—Noyes Bros. (Sydney), Ltd., 115, Clarence Street, Sydney, N.S.W.
Noyes Bros. (Melbourne), Ltd., 499, Bourke Street, Melbourne, A.
J. R. W. Gardam, Noyes Bros. (Melbourne), Ltd., 138, Murray Street, Perth, W.A.
Canada—Lancashire Dynamo & Motor Co. (of Canada), Ltd., 107 and 109, Duke Street, Toronto; also at 809, Unity Building, Montreal.
France—Rollet & Cie., 61, Rue de la Folie Mericourt, Paris.
Holland—Landre & Glinderman, Engineers, Amsterdam.
Russia—Electrical Manufacturers Co. (of Great Britain), Ltd., Miasnickaya 13, Moscow.
Spain—Macnaughtan Bros., Apartado 78, Valencia.

"THE practice of accepting the lowest tender is defended because of economical conditions and of the guarantee it affords against favouritism. But there should, at the same time, be some recognition of the fact, that just as low wages may not induce to high efficiency, because tending to delay improved mechanical means of production, so a loss in the selling price is not conducive to permanent efficiency in manufacture, as it prevents expenditure on research. As a great engineer said recently: 'Striving after cheapness will lead to the inevitable result of securing present gain at the sacrifice of future progress, for it must be borne in mind that if contractors are deprived of the margin of profit which enables them to make investigations, it will put a stop to their enthusiasm in scientific work.'"

—*The Man Power of the Nation.*

EASILY FIRST

THE OHMER INSULATION TESTING SET.

Lightest, best and cheapest
Reads direct in megohms
Accurate at all parts of scale.
Reading independent of generator speed.

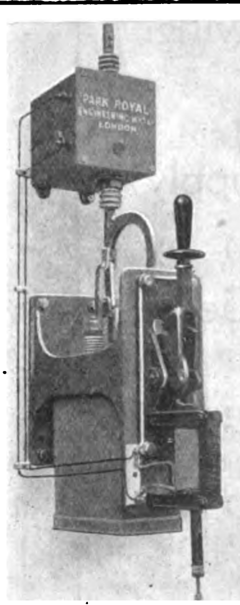
Excellent in design
Constructed to stand hard wear
Unaffected by external fields
Movement free from sticking

NALDER BROS. & THOMPSON, Ltd.

Head Office and Works,
97a, Dalston Lane, London, N.E.

Wires: "Occlude, Kinland, London."

'Phone: Dalston 2565 (2 lines).



Park Royal Engineering Works Ltd.

PARK ROYAL, LONDON, N.W.

'Phones: Willesden 2223, 2224

¶ Oil switches and transformers embodying perfect design and the finest workmanship are constructed in our new factories and have taken their place among the most reliable and efficient of

MODERN SWITCHGEAR

GERMAN PLANT IN SOUTH AFRICA

IN the course of his inaugural address delivered before the South African Institution of Engineers in July, Mr. Bernard Price said that "the experience of the Victoria Falls and Transvaal Power Co. with two leading German Electrical firms was that they had made many mistakes, and had to acquire much knowledge at the expense of their customers. He gave nearly a dozen examples, and said that, while he was ready to admit the merit of much German workmanship, design and organizing power, he did not think the A.E.G., or their German sub-contractors, had reason to be unduly proud of the record of the plant which they had installed at the Victoria Falls Power Co. with such a flourish of trumpets."

—*Cape Times.*

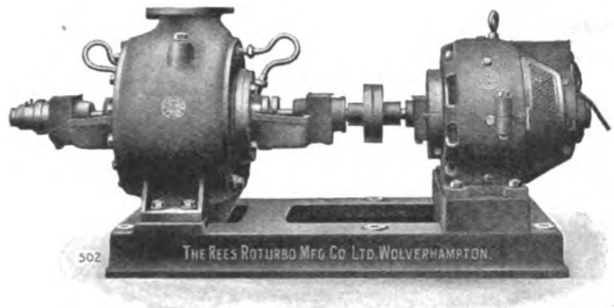
"THERE are times, I hold, in history, when war must be risked if a nation is to retain its greatness of mind, its position as a supporter, not only of its own interests, but of the vaster interests of mankind. When the rulers of any nation deliberately assail the liberties of other peoples, persecute, torture and slay by force those who withstand against their aggression, it is our duty to take sides openly against them, to protest publicly by the voice of the government against them, to hold them up to the shame of mankind, to have no friendship with them, and to back up our words by action, if necessary, even at the risk of war."

—*Stopford A. Brooke.*

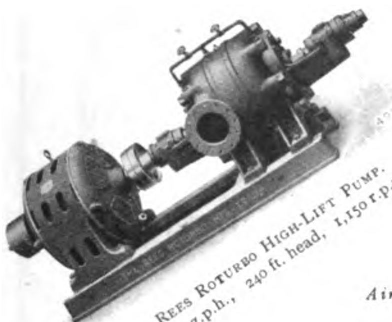
REES ROTURBO

SEND US YOUR ENQUIRIES.

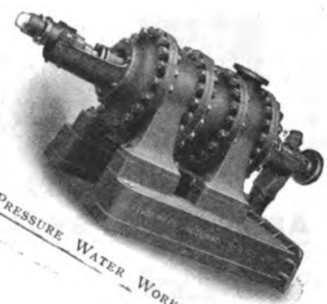
A PUMP FOR EVERY SERVICE.



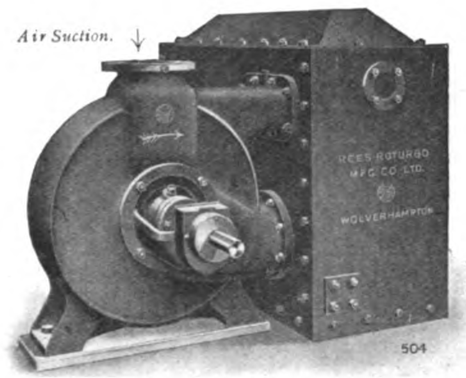
REES ROTURBO PATENT GENERAL SERVICE PUMP, WITH REES ROTURBO D.C. MOTOR.



REES ROTURBO HIGH-LIFT PUMP. 95,000 g.p.h., 240 ft. head, 1,150 r.p.m.

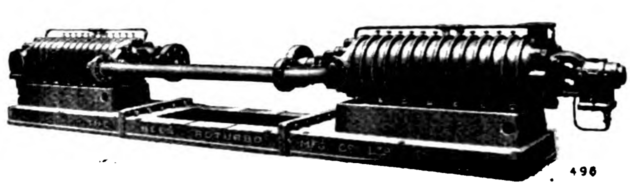


HIGH-PRESSURE WATER WORKS PUMP.

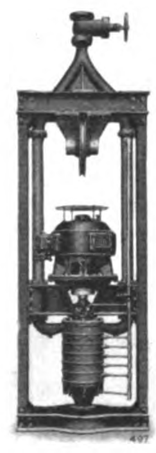


REES ROTURBO PATENT ROTARY AIR PUMP, WITH ENTRAINING WATER TANK.

REES ROTURBO HIGH-LIFT WELL PUMP, WITH D.C. VERTICAL MOTOR.



REES ROTURBO HIGH-LIFT MINE PUMP. 20,000 g.p.h., 1,480 ft. head, 1,460 r.p.m.



REES ROTURBO SHAFT-SINKING PUMP, WITH A.C. MOTOR.

THE REES ROTURBO MANUFACTURING CO. Ltd.

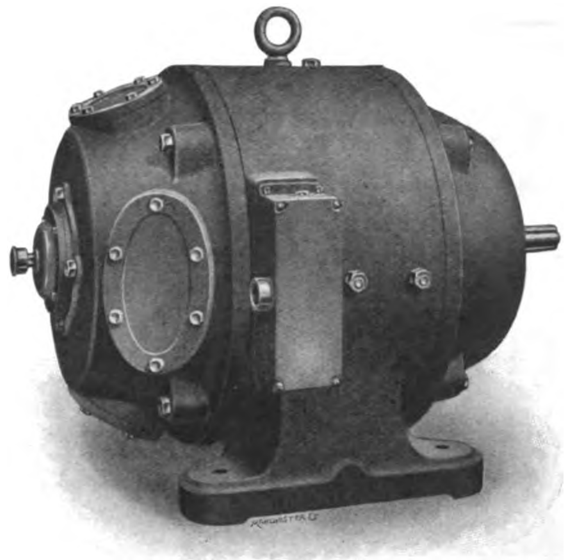
(SUCCESSORS TO THOS. PARKER LIMITED),

HYDRAULIC, ELECTRICAL & GENERAL ENGINEERS,

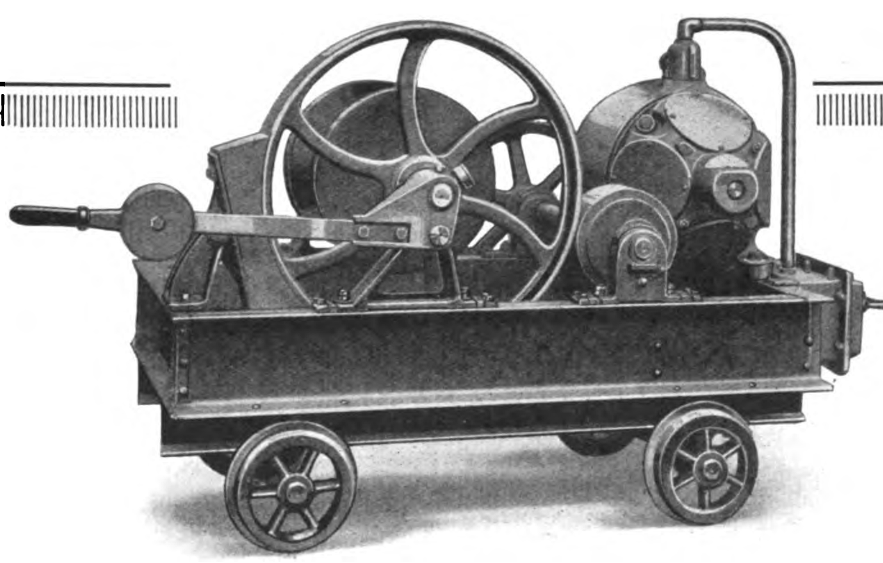
HEAD OFFICE & WORKS: WOLVERHAMPTON, ENGLAND.

LONDON OFFICE: HASTINGS HOUSE, NORFOLK STREET, STRAND, W.C.

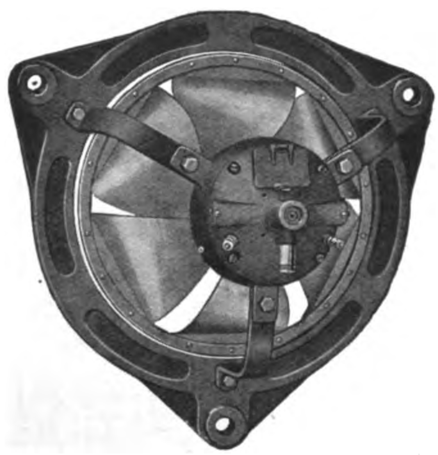
TELEPHONES: 400 Wolverhampton. 1511 Central, London.
TELEGRAMS: Hydroturbo, Wolverhampton.



DIRECT CURRENT MINE MOTOR.



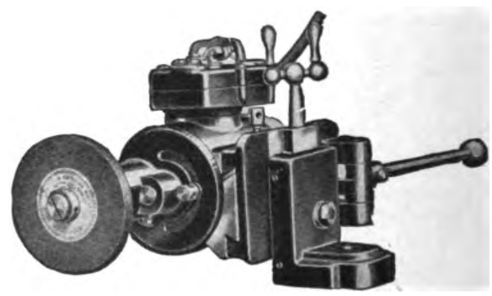
SUN VENTILATING FANS.



- Design, workmanship and material are of the highest possible class.
- Move large volumes of air with minimum current consumption.
- Run silently under all conditions, and without attention.
- Standard patterns from 12 in.—60 in. D.C. and 12 in.—48 in. A.C.
- We also manufacture Desk, Table, Wall, Ceiling, Exhausting, Railway, Ship, etc., types.

SUN PORTABLE ELECTRIC TOOLS.

A line of labour-saving tools specially designed to give continuous and efficient service. All models embody the latest designs in small motors, and run equally well on D.C. or A.C. circuits. Aluminium is used as far as possible in the construction, making them light and portable.



TOOL-POST GRINDER.

The movements and adjustments provided enable this tool to be used for all classes of grinding work on any standard lathe. Invaluable in the tool room.

Price, complete with 4 in. Emery Wheel, Flex and Adapter, **£17 15s.**

OFF-SET DRILL.

The spindle being offset, greatly facilitates drilling in corners. All gears are accurately cut. Will drill up to ¼" in steel. Maximum consumption on load, 250 watts. Price, complete with ¼" Chuck, key, handle, flex and B.C. Adapter, **£10 17s. 6d.**

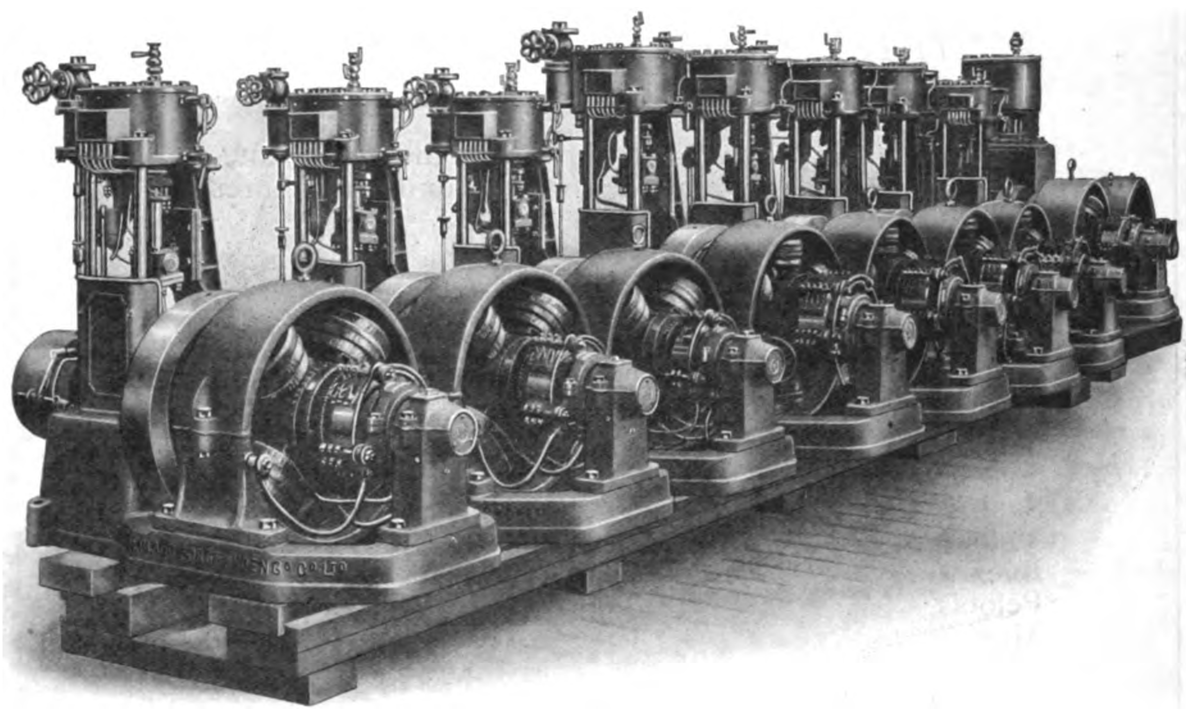
Full particulars of the above, or of anything else electrical on request. Special attention is given to all export orders, and buyers can rely on goods arriving at their destination in first-class condition.

Telegrams: "*Secabilis Ox, London.*"

The SUN ELECTRICAL COMPANY LIMITED

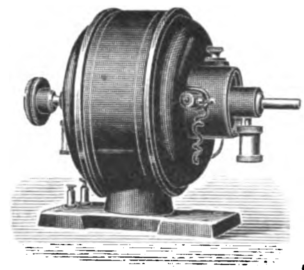
118-120, CHARING CROSS ROAD, LONDON, W.C.

Telephone: *Gerrard 2291 (3 lines).*

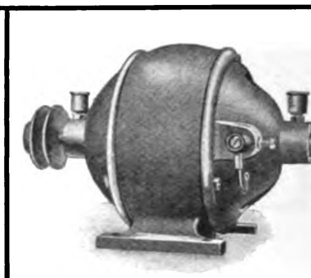


A GROUP OF STANDARD COMBINED PLANTS.

THE BRITISH PRODUCTS announced in these pages are advertised in order to carry on the export business of the country and not to under-sell the products of any other nation; they are sent to all parts of the world and are bought by those who desire to secure reliable first-class goods. Added to this sound business reason for purchasing British goods, there is another deeper reason why buyers now prefer them; they wish to contribute to the continuance of the British Empire and to support Great Britain in this titanic war for Human Rights.



Repulsion Type Motor.



Direct Current Motor.

DYNAMOS

AND

MOTORS FOR ALL TRADES

Special Motors for MEDICAL and SCIENTIFIC APPARATUS, MACHINE TOOLS, etc.

We can supply a motor for every purpose from $\frac{1}{30}$ horse power to 100 horse power.

Also "ECONOMIC" GRINDING ATTACHMENTS for BENCH AND MACHINE.

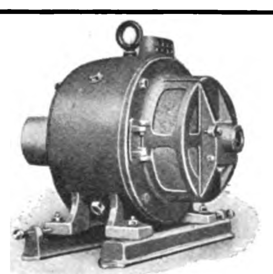
The "Economic" Electric Tool Grinders have been produced to meet the demand for really efficient and powerful machines capable of withstanding the roughest treatment at the hands of inexperienced workmen, without demanding constant attention or the frequent renewal of parts. Our aim has been to make these Grinding Machines as "fool-proof" as possible, and we have rigidly excluded from our designsall unpractical devices which reduce electrical efficiency and introduce elements of unreliability.

Contractors to Admiralty, War Office, Post Office, Colonial and Foreign Governments, Corporations, Railway and Shipbuilding Companies, etc.

WILSON - WOLF

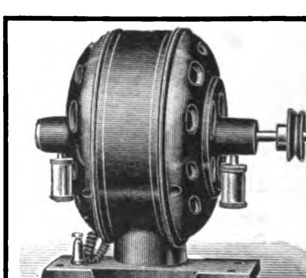
ENGINEERING COMPANY LTD.

BRADFORD



Direct Current Motor.

TELEGRAMS - - - "ENERGY, BRADFORD."
CODES - - A.B.C. 5th EDITION AND PRIVATE.
TELEPHONE - - - - 1753 BRADFORD.

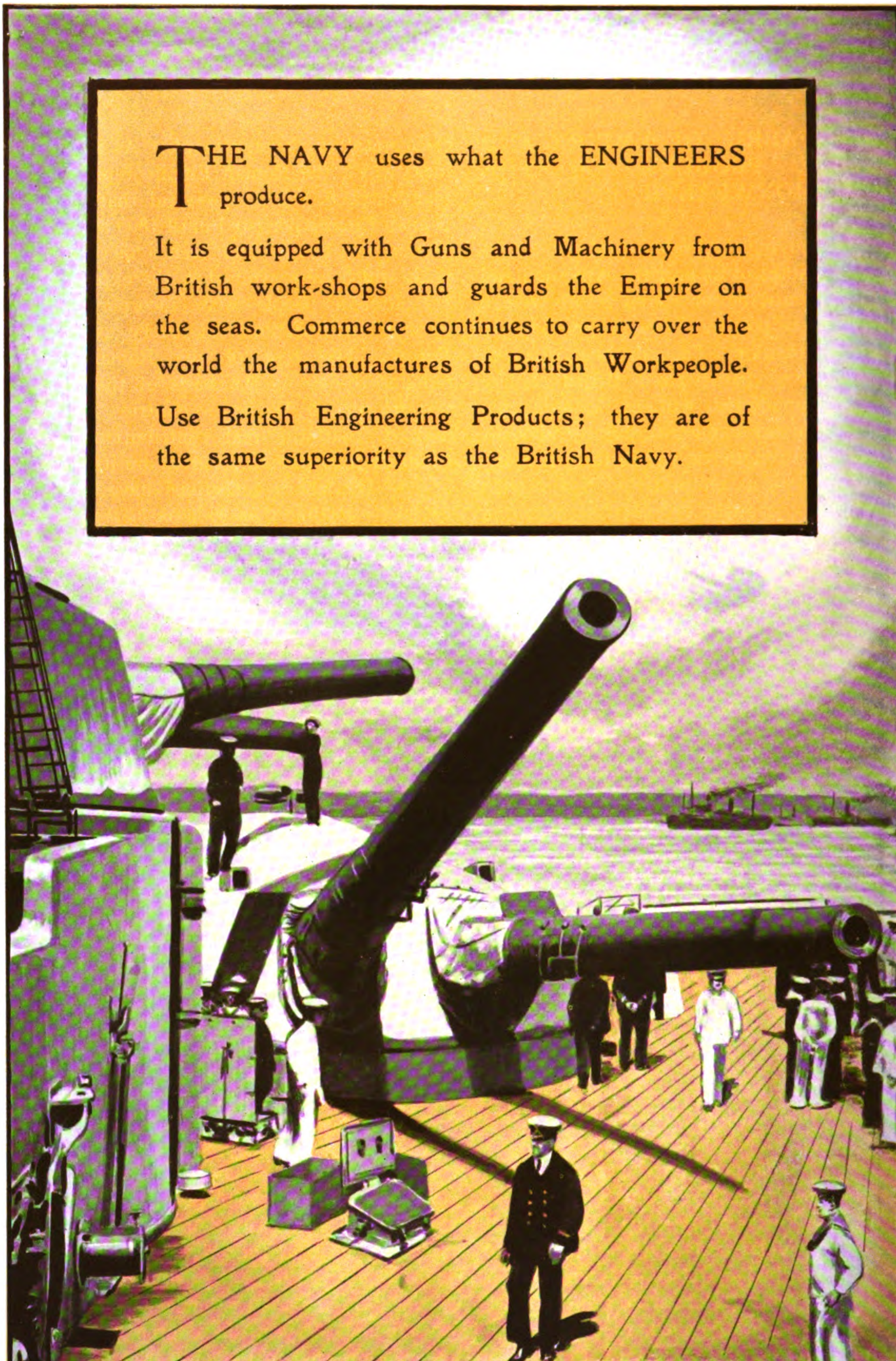


Induction Type Motor.

THE BEAMA JOURNAL

Vol. II No. 4 OCTOBER 1916

CONTENTS


THE NAVY uses what the ENGINEERS produce.
It is equipped with Guns and Machinery from British work-shops and guards the Empire on the seas. Commerce continues to carry over the world the manufactures of British Workpeople.
Use British Engineering Products; they are of the same superiority as the British Navy.

THE BEAMA JOURNAL

THE FABRIC OF EMPIRE AND "THE PROBLEM OF THE COMMONWEALTH."

In studying the present problems of the Empire the causes of its growth, expansion and pre-eminence must be considered before we can decide on future policies or dogmatize about an Imperial constitution. The principles which in the main have characterized British Policy cannot be repudiated without lessening its beneficent influence in the world and endangering the real strength of the British Empire. There is always a temptation at a certain stage in the growth of any organization to adopt a more specific, not to say rigid, formula of management, in order to fix in a secure form the development that has been attained. It is seldom that men perceive the contradiction in such a procedure, nor the danger, in so doing, of stifling the impulses which are the very life and soul of the system, organization or nation. When men accept a formula as the consummation of their purposes the end of their achievements is in sight. When the object of an Empire is "to have and to hold" in the purely materialistic sense, the possession begins to crumble in the hand, according to a law by which decay sets in when the vitalizing, unifying Principle is withdrawn. The strongest bond of union between men has always been a common allegiance to ideas in which men find liberation of their individual aspirations.

The Emperors of Rome were not content to exert their power through "spheres of influence"; they imposed taxes and regulations on their provinces in order to maintain themselves as a military power and to perpetuate the name and fame of Rome. But this was a mistaken necessity for, as Viscount Bryce pointed out in his *Holy Roman Empire*, the "barbarians" were eager to emulate Rome at one stage in its history, and flocked to its banners inspired to imitate and establish Roman customs. However, the Emperors pursued their mistaken policy and bled the provinces until the revolts ensued which finally made it necessary to remove the capital to Constantinople. As it was, the ideal which the Roman Empire represented in many aspects was so powerful that the Holy Roman Empire persisted until 1803 as an image of that which once had been a fact; and the ideas which were evolved in the experiences of the Roman people were incorporated with various modifications in every country in Europe. The best of the Roman Empire remains to-day as the basis of the judiciary systems in all Western countries. History declares that the real contributions of any civilization to human progress are its ideas.

The above reflections have been provoked by reading *The Problem of the Commonwealth.** This problem is world-old, but it has never been presented to humanity in its present form, and the future of civilization for hundreds of years will be determined by the policies which guide British Imperial statesmen as they prepare for the new era that is now dawning on the world.

The human race and all its contrasting and complex qualities appear before us in these times as an enormous panorama. The war has educed a wider consciousness in all classes than that limited by mere parochial or even national interests. This consciousness of the unity of humanity's nature and destiny has accentuated, however, the importance of individual and local problems; the significance of the unit is increased by the realization of the inter-relation of all units, small and great. Thus in every country the people are agitated politically and are confronted with critical questions in the decision of which are involved certain basic Principles. Characteristics are being sharply defined by events and men are being tested by opportunities; strong passions, subservient to human evolution, threaten disintegration and are rampant in all countries; and, contrasted with these, are greater acts of heroism and self-sacrifice, wider humanitarian sentiment, larger political idealism than the world has ever seen so widely extended. The tendencies of evolution for hundreds of years have been accumulated and concentrated in the present crisis.

* By Lionel Curtis, Macmillan & Co., Ltd.

As the war has progressed the issues have become more vividly defined in men's minds, especially throughout the British Empire. In their consciousness is imaged, more or less clearly, that Ideal Empire composed of virile individuals and nations progressing together for mutual development. As men have fought for the Empire as it is, the Empire of their dreams appears realer ; in defending the Empire many men rise into the realm where originated the Principles by which it has been evolved. And, as the Ideal Empire assumes almost a definite form in thought the desire arises to give it such a strong, secure physical form that nothing can ever destroy it. The contradiction involved in this desire is not seen. The one characteristic of physical forms of which we are certain is that they are constantly changing, continually disintegrating and being re-formed ; but That which creates never changes and never can be disintegrated ; It is secure and eternal and persists from age to age ; through It humanity is perpetuated, and its races and nations are evolved and transformed. Men have allied themselves with It in efforts to found a kingdom or an empire that will reflect in a perfect form that which they, more or less blindly, are seeking.

The Empire is more significant, vastly more tangible and indispensable to humanity than it has ever been, but at the same time the Dominions, Colonies, Dependencies and Protectorates are becoming more self-conscious of their individual status. It is a paradox symptomatic of the crisis which human evolution has reached. Each unit in the Empire realizes as never before its own power and urge toward national development, which is confirmed by the strength revealed in the assistance it has contributed to Great Britain for the defence of civilization. There are both young and old in the Imperial family, and the young demand the right to grow and develop the resources of their country, to frame their own tariffs as they see the need for it, and to impose taxes as they deem it necessary.

The problem is, therefore, one often discussed, *viz.*, how may individuality and co-operation become compatible. It is not a question as to which ought to prevail, for all thoughtful men see that these are complementary principles, and that a stronger federation may be effected by the co-operation of strong individuals than by that of weak and undeveloped ones.

The author of *The Problem of the Commonwealth* recognises this fact, and his book presents an excellent basis for the discussion of the whole question. It embodies the ideas of one school of thinkers as to the necessity at the present juncture for a "Constitution" by which the British Empire may be consolidated and more tangibly united. There is an opposite school which declares that nothing of the kind should be attempted, that the bonds of Empire should remain invisible, and that their strength has been demonstrated by the spontaneous unity in arms of all parts of the Empire against an enemy of Freedom. Therefore, say those of this persuasion, nothing should be done to disturb this delicate coherence of the Empire, and no attempt should be made to define in any way an Imperial Constitution.

Extremes meet, and the result would be the same if either of the above policies were followed to their logical conclusion ; a constitution that binds too effectively invites revolt ; nations who refuse to recognise any basis of co-operation cannot constitute an Empire.

It is necessary to make clear in our minds what we believe to be the nature and essence of the British Empire, and to consider whether that which is, in reality, the Empire, is compatible with the various ambitions and ideals of its component nations. Great Britain cannot define the direction which the other parts of the Empire will take. We might indeed prefer that the colonies should remain mainly agricultural countries and that we should continue to export to them the bulk of their manufactured requirements, and, therefore, our ideas as to the tariffs might not have the approval of Colonial governments. There are in fact in certain colonies quite strong anti-imperial parties whose views relating to tariffs, the income tax, etc., have to be considered. And in some colonies legislation has been passed which shows little concern for Imperial obligations and more for the development of their own countries. For this no country can be condemned ; but it is an indication that more frequent Imperial conferences are necessary in order to develop a reciprocal understanding of the mutual needs of the Imperial Alliance.

At bottom the Empire is now really nothing more and nothing less than an Alliance

of nations who observe allegiance to the ideas of Justice, Liberty and Self-government. These ideals depend for their realization in the world on their being carried out by the nations of which the British Empire is composed. In every nation they are being worked out in different ways and it is most essential that they should be kept ever before the people as they solve their own internal problems of administration. So long as Great Britain maintains these ideals so long will her influence be great and *on that alone depends her power to hold the Empire together.*

The constitutional history of the British Empire during the nineteenth century is embodied in a series of Acts of Parliament at Westminster, confirmed by the Colonial Parliaments and the Crown, by which the Colonies gradually took over the legislative administration of their own affairs. In a word, self-government has been "granted" to the Colonies by the mother country. The Crown, though represented in the Colonies, does not attempt to dictate in regard to legislation. It is true that Acts passed by the colonial legislatures must have the sanction of the Governor-General, who is advised by a Privy Council, the highest executive body; but, although it is appointed by the Governor-General, it can hold office only so long as it retains the confidence of the House of Commons in any Colony. The development of the British Empire in the last years has been a process of decentralization, as regards parliamentary administration, though the highest appeal in judicial matters is still the King's Privy Council in Great Britain. The British judiciary system thus represents a wonderfully unifying force, as it is possible to appeal finally to the "Crown" from all parts of the Empire; this provision prevents dead-locks and even ruptures between rival interests. It is too little recognised how important for the unity of the Empire are the system and administration of the British Courts of Justice; through these courts the ideals of Justice, Liberty and Self-government are maintained. The King's Privy Council administers justice in the name of the "Crown"—a symbol of the Empire's unity and tacitly recognised as an impersonal epitome of the highest intelligence of the people in the Imperial domains. The King's Privy Council embodies the finest judicial traditions and attainments of British civilization in the regulation of "fair-play."

The "Crown" is the focus for the union of all parties, sections and countries in the Empire; the creation of a new parliament could not of itself maintain this unity, for parliaments represent the personal elements which are jealous of each other's interests. But we salute the "Crown" as above our little aims, as above dissensions and as an expression of our ideals and aspirations for unity.

The main point in *The Problem of the Commonwealth* is the necessity for an Imperial Parliament composed of representatives from all parts of the Empire elected by the people of the different countries. The plea for this necessity is that only such a parliament would have power to distrain on the colonies for money required to finance the Army and Navy of the Empire. The argument is that at present the safety of the whole Empire depends really on the tax-payers of Great Britain. Appropriations can be made safely only on this basis as the voluntary contributions of the Colonies are not guaranteed ahead. This view is based on the assumption that as the colonies already contribute voluntarily to Imperial Defence they therefore desire to become responsible for Imperial policies and to have a share in decisions as affecting the entrance of Great Britain in a war. The author argues that, if the Colonies are not allowed representation there will, in all probability, be a reaction after this war and that there is a danger that the Colonies might secede from the Empire, as the American Colonies seceded from Great Britain after the Seven Years' War. The whole argument of this well-reasoned work is founded on this supposition and it is necessary to examine its foundation.

More than a century and a quarter has passed since the time of George III. and the situation now is not comparable with that period in hardly any respect. Conditions are widely dissimilar. Then the scattered Colonies in America were not a united nation; the executives of the several states were responsible to the King, not to the people, and there was no Federal government. To-day all the Colonies in each country are united under a Federal government responsible to the people. There can be no real clash between British *authority* and colonial *authorities,* though there may be differences of opinion in

regard to Imperial administration. To-day it cannot be a question of one authority trying to impose itself on others. Unsettled legal questions are referred to the King's courts, it is true ; but these courts are *recognised* as a final authority.

The whole question is argued as if the Colonies were possessions of Great Britain and it now becomes time to give them representation in an Imperial Parliament, for fear they may throw off the yoke of British authority and refuse to contribute to the support of the Imperial idea. Historical surveys are useful, but historical analogies are misleading in this rapidly evolving world, and this line of argument appears very much like special pleading for a pre-conceived policy of a political party.

Happily to-day policies cannot be imposed—especially within the British Empire ; they may be expounded, debated and adopted or rejected. And the problem of the coherence of the British Empire is clearly a matter for discussion in all the countries concerned, a question of conferences between them as how best to assist and encourage reciprocal interests. We do not say that the time may not come when every nation in the Empire will desire a representative Imperial Parliament ; but that institution would be the final expression of a unity of interests already thoroughly realized ; it could not be a means of increasing that unity. On the contrary, the clash of interests under such a control might lead to schism. A clearly defined constitution will not create an Empire of one will and intention.

Mr. Curtis says that none of the Colonies at present have a voice in deciding the ultimate issues of national life and death. Such a statement as this opens the complex question of Democratic Control of foreign policy. As yet the electorates in the Colonies are even more ignorant than the people of Great Britain of the mazes of the European political game and all the plotting and ambitious schemes of statesmen. The British—even our diplomats—have been accused of being too innocent and trustful. What then could be said of people reared over the seas far away from the seething states of Europe which breed war, and mostly ignorant of their history and even of their geographical relations ? It is beyond imagination to conceive that the Colonies or even the British people themselves were fitted to decide whether the British Empire ought to have defended itself against German aggression in the present war.

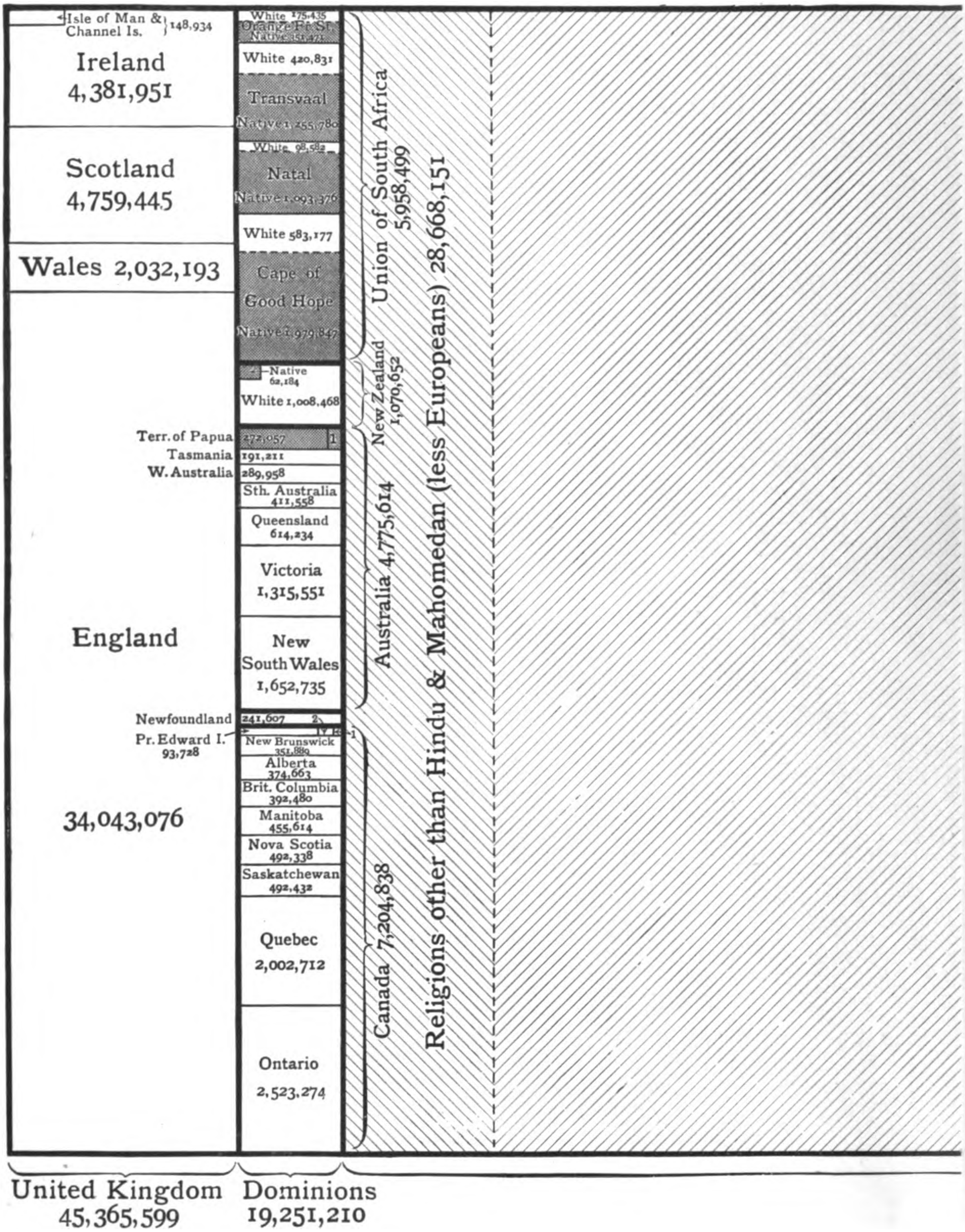
On the other hand, if the cause for which Great Britain entered this war had been trivial or merely the result of bickerings, the people would not have come to her assistance either at home or abroad. In reality the people themselves decided that they would undertake the task, and decided as they always do when confronted with clear-cut issues. The *heart* of Democracy can be trusted to take the right side when it is a question of "yes" or "no" ; but the *intellect* of the mass of the people can seldom be trusted to sift evidence, for sectional and personal claims are apt to cloud the issue. An impersonal, high-minded statesman trained to consider the principles involved can make a decision on the merits of the case ; the people then either accept or reject it. All could be educated no doubt in time to assume the responsibilities of such decisions, but this requires intelligence and knowledge of conditions and of the principles at stake. It was suggested in the first paragraphs of this article that the war had done much in this direction, but the interest in Imperial issues must be fostered by statesmen and thinkers. Moreover, an investigation of affairs in the various parts of the Empire does not suggest that the Imperial idea is uppermost in the minds of the people of these countries.

The Round Table (the June issue especially) presents valuable first-hand information on the conditions in the different countries, and a careful perusal of these articles reveals facts that rebuke ambitions for the early establishment of an Imperial Parliament elected by all the people of the countries in the Empire.

Any observations made in this country on the political tendencies of other countries in the Empire must be, *per force*, mainly academic. Without extensive travel and observation on the spot we can only read the history of events as they are recorded, and the opinions of statesmen and journalists in the different territories.

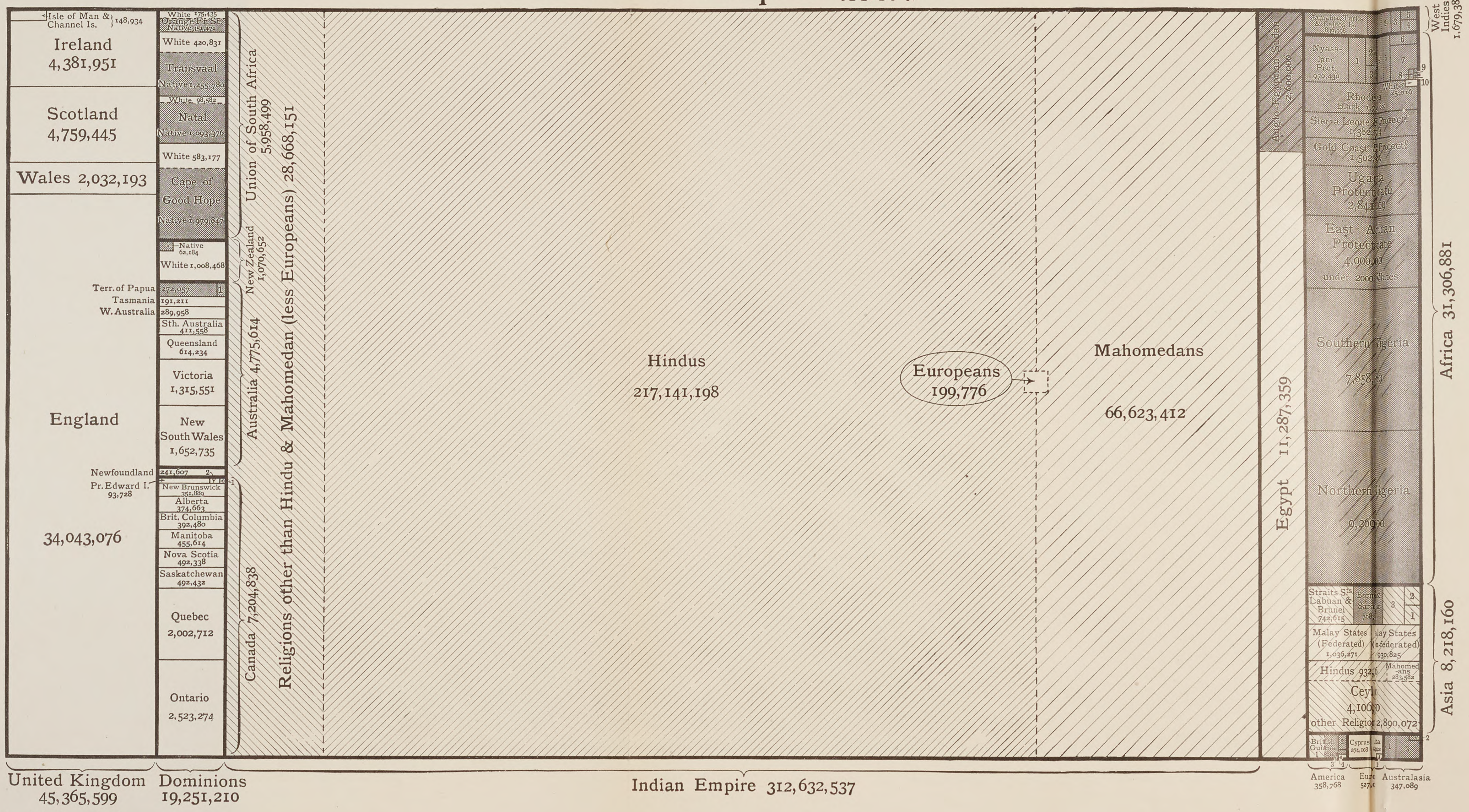
In South Africa the events of the last two years show the difficulties of inaugurating a non-racial government out of the conflicting sectional and personal interests ; these are admirably described in the articles on South Africa in *The Round Table.* Only clever statesmanship has held the four colonies

The Bri



From *The Problem of the Commonwealth.*
By permission of Messrs. Macmillan & Co., Ltd.

The British Empire 433,574,001



From *The Problem of the Commonwealth*.
By permission of Messrs. Macmillan & Co., Ltd.

White populations are left unshaded.

Asiatic populations are shown by plain diagonal shadings.

Primitive populations are shown by cross-hatching.

Primitive populations that have adopted the Mohammedan religion are shown with a broad diagonal shading superimposed: where the number of Mohammedans is not accurately ascertained this shading is shown indefinitely in the middle of each rectangle.

Where the scale does not permit of the name and population being entered in the diagram, numbers are inserted as follows:—

CANADA:
1. Yukon 8,512
2. N.W. Territories . . . 17,196

AUSTRALIA:
1. Northern Territory . . . 28,310

AMERICA:
1. British Guiana . . . 129,139 Asiatic
1a. British Guiana . . 166,902 other than Asiatic
2. British Honduras . . . 40,458
3. Bermuda . . . 18,994
4. Falkland Islands . . . 3,275

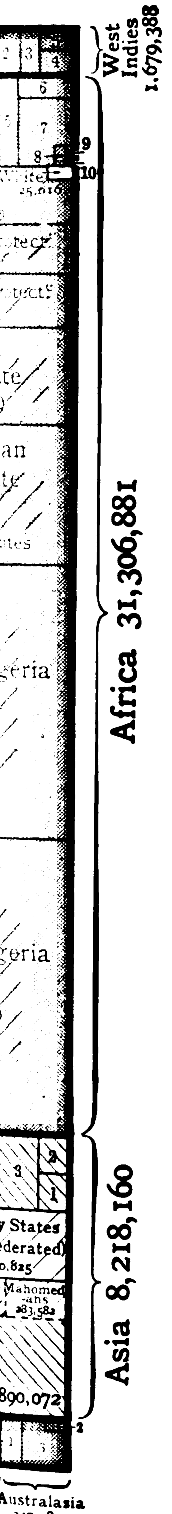
EUROPE:
1. Gibraltar 24,460

AUSTRALASIA:
1. Fiji 139,541
2. Tonga Islands . . . 23,737
3. Unattached Pacific Islands . 183,811

ASIA:
1. Weihaiwei 147,177
2. Bahrein Islands . . . 90,000
3. Hongkong and Territory . . 456,739

AFRICA:
1. Basutoland 405,601
2. Bechuanaland 125,350
3. Swaziland 99,959
4. Somaliland 344,323
5. Zanzibar 197,199
6. Gambia and Protectorate . . 138,400
7. Mauritius 370,393
8. Seychelles 26,000
9. St. Helena 3,520
10. Ascension 400

WEST INDIES:
1. Trinidad and Tobago . . 330,093
2. Barbadoes 171,892
3. Windward Islands . . . 157,272
4. Leeward Islands . . . 127,189
5. Bahamas 55,944



White populations are left unshaded.

Asiatic populations are shown by plain diagonal shadings.

Primitive populations are shown by cross-hatching.

Primitive populations that have adopted the Mohammedan religion are shown with a broad diagonal shading superimposed: where the number of Mohammedans is not accurately ascertained this shading is shown indefinitely in the middle of each rectangle.

Where the scale does not permit of the name and population being entered in the diagram, numbers are inserted as follows :—

CANADA :		
1. Yukon	8,512	
2. N.W. Territories	17,196	
AUSTRALIA :		
1. Northern Territory	28,310	
AMERICA :		
1. British Guiana	129,139	Asiatic
1a. British Guiana	166,902	other than Asiatic
2. British Honduras	40,458	
3. Bermuda	18,994	
4. Falkland Islands	3,275	
EUROPE :		
1. Gibraltar	24,460	
AUSTRALASIA :		
1. Fiji	139,541	
2. Tonga Islands	23,737	
3. Unattached Pacific Islands	183,811	
ASIA :		
1. Weihaiwei	147,177	
2. Bahrein Islands	90,000	
3. Hongkong and Territory	456,739	
AFRICA :		
1. Basutoland	405,601	
2. Bechuanaland	125,350	
3. Swaziland	99,959	
4. Somaliland	344,323	
5. Zanzibar	197,199	
6. Gambia and Protectorate	138,400	
7. Mauritius	370,393	
8. Seychelles	26,000	
9. St. Helena	3,520	
10. Ascension	400	
WEST INDIES :		
1. Trinidad and Tobago	330,093	
2. Barbadoes	171,892	
3. Windward Islands	157,272	
4. Leeward Islands	127,189	
5. Bahamas	55,944	

ti

H

217

Inc

together, and the evidence makes it appear very doubtful, indeed, whether the electorate would cast a majority vote for the establishment of an Imperial Parliament such as Mr. Curtis proposes.

The article on Canada in the June number of the same periodical is evidently written by one of the same political persuasion as the party now in power in that country, as it gives no hint of the feeling of a large section of the community who would put Canada before the Empire. These are not popular topics in the press to-day for good reasons, and that is why it is easy at the moment to theorize on the possibility of a new Imperial Parliament. The article referred to says that "for the last decade the staff officers who guided the re-organization (of the Militia) had in mind participation in a European war rather than a defence of our land frontiers. . . . This measure of preparation however, had been made as an intelligent anticipation of events which were foreseen *by a few administrators and was not part of the conscious policy of the country.*" One wonders whether, if the electors had been consulted, these plans would have been a conscious policy of the country and whether the Canadian Government would have been in a position to telegraph its offer of an Expeditionary Force on Aug. 1, 1914, on the advice of its military administrators "who then knew exactly what steps they needed to take."

The Toronto Globe, Canada's leading Liberal organ, in an editorial on Mr. Curtis' book says :—

> . . . Canada and the other overseas Dominions cannot hope to control foreign policy and issues of peace and war so long as there are forty-six million white people in the British Isles and about sixteen millions in all the overseas nations. To secure even a minority voice, the Canadian people, besides providing for their own local defence such forces as might be considered necessary, would, in equity, have to pay over forty millions a year for the maintenance of the Imperial army and navy as they were before 1914. That proposition will require a good deal of consideration. Another and a much more serious one, which Mr. Curtis ignores, but which no Canadian statesman considering the question of Imperial defence dare ignore, is how the Dominions could guarantee a sufficient number of trained men to be used in overseas service at the call of the Imperial Government. Not only in Canada, but in all the Dominions, the guaranteeing of large bodies of trained men for overseas service might prove to be a much more difficult thing than the providing of money for their maintenance and equipment.

As regards Australia, it has been lately personified for us in this country by Mr. Hughes' strong Imperial sentiments. Stray paragraphs from Australian papers, however, have appeared in the press here, and evidently emanate from parties who seek, as they think, to keep a balance and who will not allow Australia to be obliterated in any grand Imperial scheme. It is not generally known in this country that recent legislation in Australia is discouraging to British manufacturers who do business in this Dominion. The *ad valorem* duty on goods going into Australia has been increased because of higher prices here. We look upon the Colonies as part of the family and take them in "on the ground floor" so that they have full knowledge of our manufacturing conditions and prices. But the conditions in Germany and America cannot be checked and the goods may be invoiced for the duty tax at a false value, so that the manufacturers of these countries can profit in the Australian market at the expense of British manufacturers. The "preference" to Great Britain thus becomes negligible. The new Federal Income-tax Law is also a measure of self-protection for Australia which bears very heavily on British manufacturers who sell goods in Australia ; even though not resident there nor registered there as a company, they are to be taxed by the Commonwealth Government on the same income as that on which they have already paid heavy British income, war and other taxes.* This Commonwealth tax is in addition to that already imposed by the separate states of Australia.

From a purely British point of view these measures are a bit rueful. It appears that the Dominions have the power to "distrain" on the Mother Country ! What disturbances there would be in our well-planned Imperial Parliament ! It were better to strengthen our means of conference and common councils until a basis more satisfactory to all is reached.

The articles in *The Round Table* on Australia describes its Economic Development and the differences between the several Australian states regarding the basis of financial administration. Government officials in that country are, on the evidence of this article, newly learning the science of finance, and until they know more about it and until the different states are agreed as to their relation to the Commonwealth in fiscal matters, import duties, etc., it is somewhat premature to think that they would be prepared to give an Imperial Parliament power to distrain

* Income Tax Assessment Act 1915 (No. 34), Amending Income Tax Assessment Act, No. 2.

on them for Imperial Defence. "Government is in all directions laying heavy bands on commercial and financial operations; and, in doing so, the will to organize may very easily manifest itself as a power to disorganize," says the writer in *The Round Table*.

There is an academic aloofness in the plan that one set of men should be elected to the Imperial Parliament to deal with foreign affairs—chiefly as connected with the question of war and the maintenance of the army and navy—and that another set should be elected to the National or Federal Parliaments to deal with purely national affairs.

Nearly all national affairs in every country ***are now national in relation to other countries;*** local affairs are dealt with by the Provincial and State Parliaments. It is even a frequent contention between State and Federal assemblies how to define clearly the province of each. And if a third set of representatives were elected to an Imperial Parliament it is very possible that the Imperial Parliament would soon come into collision with the Federal or National governments, as they might be jealous of each other's powers. The National Parliaments already enact legislation as affecting their relation to other countries within as well as without the Empire. The domestic matters with which a National Parliament deals have in many cases a foreign aspect and *vice versa*; there are few things purely domestic or purely foreign and two Parliaments elected with these distinct functions would soon find themselves in confusion. Many things which we have been accustomed to consider purely domestic have, since the war, assumed a foreign aspect. The Foreign Office in Great Britain has now established a Foreign Trade Department which must imply knowledge of domestic trade; the Board of Trade is concerned both with the domestic and foreign aspect of trade; the Postal Department is also related to both, etc., etc. If the electors could separate the men who manage purely domestic matters from those who are to deal with foreign affairs only, they would achieve a new thing in scientific classification. This is the proposal in *The Problem of the Commonwealth*, though in it the chief "foreign" matter is Imperial Defence, and the main object in setting up new machinery and a third Parliament, is that it should meet for the purpose of voting supplies and imposing taxes. But one must ask how a Parliament divorced from domestic affairs could be in position to intelligently distrain on the different countries for monies.

It is also urged that the Federation of provinces in Canada, of states in Australia and New Zealand, of the English, Welsh and Scottish Parliaments; that the Union of States in America and in Germany—all indicate the inevitable direction of the British Empire. But the British Empire is unlike any other Empire or Federation of States known to history. Contiguous territory has always been a condition of such Federations; between the different parts of the British Empire, however, rolls "the salt, unplumbed, estranging sea." And this enforces the necessity for relying on a deeper source of unity than physical propinquity or written agreements. It must be ***a unity in ideas;*** the oceans cannot divide that Empire.

The views which the best British and American jurists hold with regard to international relations and the developments of International Law are based on principles which apply equally in national and imperial affairs. In writing in ***The Westminster Gazette*** on ***The "Blockade" with Reference to The Declaration of London***, Sir Alfred Hopkinson, K.C., says:—"... . International Law, while based on some broad permanent principles, must be capable of growth and adaptation to new circumstances; ... the decisions of courts honestly endeavouring to administer justice in accordance with these principles will be a better guide in working out a system of law than any elaborate attempts at *à priori* codification."

Now it must be contended that there has not been as yet sufficient interchange of experiences and ideas between the governments of the different nations in the Empire, nor a sufficient assimilation or working out together of mutual aspirations, to yet make clear specific lines of codification.

Before this is attempted the weak spots in our chain of Empire must be strengthened. Indian and Irish grievances should be settled. A permanent Imperial Council in London would be much more useful to the people of the different countries at the present juncture than an Imperial Parliament, especially if it contained the colonial High Commissioners in London and other representatives from the colonies. The present Imperial Conference should meet more frequently; the Permanent Council should be contained in it, and if, in addition, it was composed of representatives of all political parties in each country, its recommendations to the several governments would have attention.

SCIENCE AND INDUSTRY, BY MILES WALKER, M.A., M.I.E.E.

The article on this subject which appeared in the January number was one of the last writings from the pen of Silvanus P. Thompson. The author has since left us; but his pronouncement on a subject upon which he felt so strongly, is there recorded in black and white, and will continue to aid the cause for which he did such excellent work. In several ways man is immortal, but in no more scientifically demonstrable way than this: that he can record his opinions upon the written page, and for all time his living words are there to battle for the cause and to carry conviction on a wider field than ever his voice could reach.

The article cites some of the most striking instances in which we of this country have been remiss in applying science to industry, and makes an excellent summary of the remedies that are needed.

In the present article I wish to say something of the qualities which we Britishers have available, and which may enable us to rise supreme, notwithstanding our great delinquencies. When we know ourselves to be backward in so many ways, the possibility of catching up with the countries which have already obtained a start and which are going ahead at a constantly accelerated pace, would appear hopeless, unless there are other things that count more than a good start.

We have all heard of the dull schoolboy, slow with his sums, mumbling and halting in his answers, untidy in his copybook, clearly no match for the energetic, quick-witted boys that keep far above him in the weekly list. Years pass by, some of the more obvious defects of the boy are patched up, then something else begins to count—thoroughness. It is sometimes called genius, but is nothing more than the habit of getting to the bottom of things, and at all cost of time and effort and *appearance* understanding a thing thoroughly. More years pass by, and the quondam schoolboys, casually meeting, go over the old school-list and ask each other what their playmates are doing now. "Blakeley, you remember him, a good cricketer, top of his form; he is a merchant in London, doing splendidly." "Smith, who ran him very close, is a banker—married well, I am told." "Oh, and how about old Dumps?" "Didn't you know? He was awarded the Nobel prize in physics last year."

No one will be so mistaken as to suppose that the possession of the slow boy's faults is evidence of genius; but the point I wish to emphasize is, that it is necessary for us to aim at his thoroughness, and not merely to be content with the smartness and business abilities of his school mates.

There is evidence that the slow boy's virtues are to be found in this country. Perhaps no other land has produced so many prominent men in science—men who by their work have led to new developments of the first importance; but it is not only in these pioneers that Britain has shown her fine material. Among the rank and file of the young engineers turned out by our universities and technical colleges there are to be found men of a quality not to be beaten in any other part of the world. Indeed, it has been demonstrated by at least one great manufacturing firm that the British student is more self-reliant and better able to go back to first principles when attacking new problems than the average man trained in the Continental schools, notwithstanding their much-vaunted technical advances and costly equipment. Then why is it that we are behindhand? Partly because this fine material has not reached the stage when it can take control, but mainly because there is not enough of it.

Whatever can be said of the possibilities of the garden of British character, it is certain that we do not sow enough of the right seed, and do not make sufficient effort to foster the plant "thoroughness." Indeed, the horticultural conditions under which the finest known specimens have been produced, are seldom referred to in essays on science and science teaching. Take a few names that are uppermost in our minds when we think of the history of physical science: Newton, Faraday, Kelvin. What was the essence that raised these men above the hundreds of other workers in the same field? If we say it was the flash of intuition given by special grace to a favoured few, or an inborn inspiration that led them to discoveries along paths not followed by ordinary men, then I very much doubt the conclusion, though I admit that the inborn ability was there. But if we say that they ordered their lives on a simple, direct plan, always true to themselves and hence true to everything, sparing no pains

and efforts to get at real facts—if we affirm that they attacked their problems with a self-sacrificing devotion that was deeper than most men give, and that they discovered laws of Nature because Nature reveals them only to those whose research is, in actuality, an unspoken prayer for truth; then, call it what you will, genius or the faculty of taking infinite pains, that is the faculty which made these men prominent. But note: it is a faculty that is not denied to other men.

In the study of science, as in every other activity, the first essential to success is integrity of character; and it is because I believe that we have in the British race great possibilities of the rearing of staunch men, that I believe we can yet become supreme in the field of science. Let us produce ten thousand Baden-Powells, and it will only require a little guiding, moulding or directing of education to produce ten thousand master minds of science and of industry.

To enter upon the methods of achieving this result in our schools would lead to a discussion the range of which lies outside the subject matter of this article. One thing, however, is clear, we must put more emphasis upon the development of character than upon progress in scholastic accomplishments. A good equipment for a science student comprises a habit of mind that "carries on" in the face of an intellectual difficulty, an integrity that cannot be satisfied with a mere show of success and a great capacity for work. This latter quality is nearly always associated with great physical fitness and it is therefore incumbent on all our educational institutions to pay a great deal of attention to the student's physical training and give him every opportunity of keeping his health up to the highest perfection throughout his course. A student should be a laughing lump of well-being instead of the melancholy neurotic so often found among the men who are earnest in their work.

I lay stress upon these matters, because if we neglect them then we cannot achieve great things, but given a sufficient number of Britishers, well versed in the Great Philosophy, we can easily leave behind legions of Mid-Continental scientists reared only on "Kultur."

The methods of teaching in our scientific and technical universities comes next in importance. Given teachers imbued with the same spirit as I have tried to outline for the student, we need not fear for the success of any method. So far as engineering is concerned, we should have a four years' course instead of the usual three years' course. Three years is too short a time to give an engineer the training he should have. It may be that the full diploma in the future will only be awarded to men who have worked satisfactorily for several years in the factory. The degree of engineer will then have a real meaning and the part taken by scientifically trained men will be much greater than it is at present.

In the past the college-trained man has found employment in positions such as those of tester or designer where his technical training was indispensable, but there is no reason why his course at college should not be adapted to make him specially competent as a shop superintendent or manager. The managerial staff in the future will more and more frequently be chosen from technically trained men who appreciate the wealth that lies uncovered in the mines of experimental research. Such men realize that the world yet unexplored is a thousand times larger than the world we know; and in days of keen competition it is more promising to build a new platform in the new world than to try to push someone else off the old platform that is already crowded. They also appreciate the importance of educating the manual worker so that he is not only more skilful in his handicraft, but is so informed in cognate matters as to take a wide interest in his trade and appreciate the true relations that should exist between capital, management and labour. There is an enormous field for endeavour in the education of the worker. In the closer union of science and industry for which we are striving the bringing of science to lighten the work and brighten the outlook of the many is of more importance than the application of abstruse theorems to the solution of individual problems.

The most direct way of bringing about the desired union of science and industry, is to fill up a great number of the well-paid positions in our industries with scientifically-trained men. The number of men going through our universities, even in pre-war days, was not one-fifth of what it should be. We want a great army of men imbued with the right spirit who may staff our industries in all capacities—especially in the capacity of trained researchers.

The question of how industrial research can best be conducted, is one which has been much discussed recently. Is it better to have all research organized and installed in a national central institution or is it better to let it grow wherever it will? There are some classes of physical enquiry that, like rare plants, will only grow on a particular soil. Under the inspiration of a particular individual or nurtured by the traditions of a particular place they flourish and give to the world wonderful fruit. Any attempt to transplant them might end in the losing of the strain forever. Such researches should be watered by the State with suitable funds and facilities, but no interference should be made with their mode of growth. There are, on the other hand, many problems the solutions of which have for long been wanted and which are most likely to be solved (if at all) by being attacked on a large scale by many workers with almost unlimited funds behind them. As an instance, one may cite the more direct utilization of the sun's radiant energy. There are millions upon millions of horse-power going to waste on our deserts and mountain wilds, but we bask in the rays and do nothing. The problem is too big for any individual. If it cost a hundred million sterling to get at a solution with an efficiency of only 20 per cent. it might still be one of the finest investments ever made. Then there are the questions of the more economical consumption of coal, the more universal distribution of electrical energy and numerous large chemical and electro-chemical problems that can be carried out with greater expedition under State aid than by private firms. For these matters we want an extension of the National Physical Laboratory which has already done such good work. As soon as we have the right kind of workers available the State should provide funds on a copious scale. In fact we know that it will be done. Just as in America millions are expended on scientific investigation, so in this country the money will be found. The return from this expenditure will depend upon the spirit of the workers.

A great deal of industrial research will have to be carried out in our factories as at present. Some of it is inseparable from the manufacture of articles in large quantities. Experiments are made and the effect watched on the finished article. Then again, some experiments involve the use of heavy machinery such as is only available in large commercial installations. Too often in the past our manufacturers have failed to make use of facilities which only present themselves on the occasions when a new installation of large machines is completed and available for measurements difficult to obtain at other times. On these occasions it often happens that a little thing intervenes to prevent proper experiments being made. The delivery of the plant may be late and the buyer may be in a hurry to start up; no proper instruments may be at hand; or it may be that the man who would make the tests is busy somewhere else. The real reason is that those in control have not previously had a fixed determination to make experiments and collect information even at the cost of further effort and some inconvenience to all concerned. Matters are much better to-day in this respect than they were; the value of experimental work is becoming recognised and the accession of more trained men will give greater facilities.

A larger share in the research work of the country will in future fall upon our universities, which in addition to advanced physical research will take up work closely connected with industrial developments. In this they will be greatly aided by funds made available through the agency of the Committee of the Privy Council for Scientific and Industrial Research. A much closer intimacy is growing up between our manufacturers and the colleges in their immediate neighbourhood, and is bringing advantages to both. The manufacturer can supply real living problems and the machinery necessary for their investigation, while the college will supply the men and instruments not ordinarily found in works. This brings the student in contact with the works during his university course and gives him an opportunity of exercising his ingenuity and resource.

In addition to co-operation between the manufacturer and the university, we must also have co-operation between the manufacturers themselves in the matter of researches in which the whole industry has a common interest. Manufacturers must be prepared to pool their special knowledge in certain branches and assist in forwarding new raids into the unknown territory, for the problems arising in some industries are too numerous and too difficult

to be dealt with by individual firms. If we do not combine we may be beaten by powerful foreign combinations. There will still be left plenty of work for the individual firms to tackle by their own experts.

Small manufacturing firms are sometimes handicapped in not being able to pay men with special qualifications. One of the ways in which the State could assist would be in providing the services of highly-trained men to help smaller firms to overcome occasional difficulties. Many matters which are now slurred over on account of want of opportunity would be sifted to the bottom and remedied if upon application to a Government Department a trained researcher in the pay of the State could be supplied. The man would go to the works and clear up the difficulty if he could, and if he could not and the matter was of sufficient importance it would be passed on to the State institutions for more complete research. The fees payable for such work should be fixed on a reasonable scale; and in cases where the whole industry gained a greater advantage than the individual firm, no fees should be payable. We would thus have a new profession to which our mathematicians, physicists, chemists and engineers of all kinds could aspire and in which their abilities would be much more actively employed than when they are compelled to seek a livelihood in some distasteful occupation. If we will only give the talents of our young men more to do, and pay for them better than we do, there will be no lack of good material presenting itself for training at our colleges. And then we must take care to turn out a finished product worthy of the fine raw British material that goes through our hands.

Whatever may have been our delinquencies in the past, the fine strain of the national character is still there, and if we will but turn it to the best account the spirit of Newton and Faraday will give to our industries such a breath of life and vigour as they have never known before.

ELECTRICAL INDUSTRIES IN SPAIN.*

By EDUARDO GALLEGO, Commander of Engineers, and Secretary of The Spanish Electrical Union.

Among the many industries which may be classified under the heading of Electrical, none has developed to a larger extent nor attained such importance in Spain as the production of electrical energy, followed immediately by electric traction, electro-chemistry and the manufacture of material. I give below a synthetical *résumé* of the present condition of these industries, closing with some remarks about their future possibilities.

PRODUCTION OF ELECTRIC POWER.

In 1878 was established in Santa Catalina (Baleares) the first Spanish plant for the production of electrical energy; another followed in 1880 in Algüaire (Lerida), and a third one was erected in Deusto (Biscay) in 1882. All these plants were of modest dimensions and had for their object the supply of current for the lighting of the small places just mentioned. At the end of 1901 there existed in Spain 859 electrical power houses, of which 211 were for private use and 648 for public supply, these latter totalling 113,933 H.P. Of the said 859 establishments, 257 were using steam power, 426 hydraulic power, 63 gas engines and 113 mixed power.

Until 1901, power houses of from 100 to 250 kilowatts were in the majority, there being only fifty-five with a capacity of from 250 to 1,000 kilowatts, six of from 1,000 to 5,000 kilowatts, and a smaller number having between 5,000 to 10,000 H.P. One of these latter was that established at Cartagena with steam engines, its object being to supply the mining zones of Cartagena and La Union by a transmission line at 11,000 volts.

More than half of these electric stations produced direct current, being very near the places to which they supplied the power; some 225 used single-phase current, seventy-five three-phase and about fifty the two-phase current.

The development of the industry under consideration has continued on a large scale during the last fifteen years, having as its most conspicuous features the extension of the use of power generated in falls of medium and

* Translated by M. Attias and Frank Broadbent, M.I.E.E.

large power, the creation of important undertakings to exploit these falls, a considerable increase in the distances of power transmission as a consequence of the adoption of higher voltages ; and as logical sequence the extinction of a large number of small central stations which are absorbed by important undertakings, and the transformation of other establishments which keep their steam engines as a reserve and use hydro-electric power during the larger part of the year.

Every large capital (Madrid, Seville, Valencia, Saragossa, etc.) has found means of utilizing the power generated in waterfalls ; Barcelona, however, has undertaken this work somewhat later, but a large plan is being developed to supply advantageously with hydro-electric power the industrious Catalan region.

According to the latest official statistics, published in 1915 by the *Dirección general de propiedades e impuestos* (Department of landed estate and taxes), 2,585 electricity works with an approximate aggregate power (including storage batteries) of 700,000 H.P., and a yearly production of about 2,500,000,000 kilowatt-hours, paid taxes in 1913 to the public treasury.

WATER AND COAL.

The statistics published in 1904 by the Office of Agriculture, Industry and Commerce, fixed at 50,000 the hydro-electric H.P. used by factories, power stations and industrial establishments, and the *Reseña geográfica y estadística de España en* 1912 (Geographical and Statistical Review of Spain for 1912) published by the Institute of the same name, gave as 1,088,528 H.P., the power of the falls used in provinces.

A conscientious investigation carried out last year covering the same works by the *Unión Eléctrica Española* (Spanish Electrical Union) shows that out of the 6,000,000 H.P. which the water courses of our country can supply, more than 1,000,000 are already being used, and those transformed into electricity were on the 1st of January, 1915, 450,000 H.P., which number will increase to 700,000 H.P. when the splendid Catalunna installations are finished ; and it may be added that by taking advantage of the Pyrenean falls 1,135,000 H.P. can be carried to the aforesaid region, the concessions already made totalling 800,000 H.P.

Even for 300,000 H.P., which is a figure larger than one-third of the concessions, supposing an average daily output of eighteen hours, this would represent 5,400,000 H.P.-hours per day ; and for a year of 300 working days, $300 \times 5,400,000 = 1,620,000,000$ H.P.-Hours ; so that if we accept 8 *céntimos* (0·76d.) as the average cost of production of one H.P.-hour, with coal at the normal price, the above 1,620,000,000 H.P. obtained with water would represent approximately £5,180,000, of which about 60 per cent., or approximately £3,100,000, would correspond to the cost of coal used.

We can arrive at the approximate cost of coal in another way, *viz.*, by supposing an average consumption of 1·75 kgs. (about 3·9 lbs.) of coal per H.P.-hour produced. As 1,620,000,000 H.P.-hour represents 2,835,000,000 metric tons of coal, this quantity at the average price of 26 *pesetas* (about 21/3) per metric ton, free on board Spanish Port (the price quoted during the first six months of 1914, or before the war was declared), comes to about £2,900,000.

Now, as the coal consumption in Spain exceeds by about one-third* the national production, it means that by utilizing water about £2,400,000 have been prevented from leaving Spain, a sum which certainly would be larger taking into consideration the extraordinary increase of coal in these last years.

According to the order of their productive power, the following are the most important electrical companies established in Spain :—

Fuerzas y Riegos del Ebro, Barcelona ; has 301,700 H.P. in five falls and uses already 40,000 H.P.

Energía Eléctrica de Cataluña, with headquarters in Paris, possesses 200,000 H.P. and uses 50,000 H.P.

Hidro-Eléctrica Española, Bilboa ; has 29,000 H.P. and uses 20,000 H.P.

Hidro-Eléctrica Ibérica, Bilboa ; possesses 30,000 H.P. and exploits 16,000 H.P.

Unión Eléctrica Madrileña ; 21,000 H.P. ; 14,000 in use.

---

* The imports of coal during the five years 1909—1913 were, according to official data, the following :—

During	1909,	2,055,736	metric tons.
,,	1910,	2,021,716	,,
,,	1911,	2,455,166	,,
,,	1912,	2,322,607	,,
,,	1913,	2,701,913	,,
Total amount,		11,557,138	

Average importation, 2,311,440 tons ; approximate yearly consumption, 7,000,000 tons.

There are besides forty companies exploiting large plants, *i.e.*, with a power above 1,000 H.P.

The most important are given below in the order of their voltage and distance of transmission :—

Fuerzas y Riegos del Ebro: 110,000 volts; distance, 112 miles.

La Energía Eléctrica de Cataluña: 88,000 volts; 112 miles.

La Hidro-Eléctrica Española: 66,000 volts for transmission to Madrid, a distance about 157 miles.

Unión Eléctrica Madrileña: 50,000 volts for transmission to Madrid, 48 miles.

La Sociedad General de Fuerzas Hidro-Eléctricas has projected a transmission line to carry 44,000 H.P. from the Seira's fall to Barcelona, a distance of about 140 miles, using a tension of 140,000 volts, which I think is to-day the highest in Europe. All currents are three-phase.

Transmissions from 6 to 60 miles are in general use with voltages ranging from 8,000 to 30,000 volts.

Generally speaking, in Spain rivers are of very variable flow—torrential in winter and with very low-water marks in summer. Hence the necessity of building large dams in order to regulate the water and also the need for erecting storage reservoirs. The largest mole is the one projected for the fall of Fayon on the Ebro some 165 ft. in height, which is being built by *Fuerzas y Riegos del Ebro*. The mole of the Hidráulica Santillana is 92 feet high by 2,475 in length; that of the fall of Bolarque is 84 feet in height.

The largest fall is that of Capdellá, Lerida, exploited by the *Energía Eléctrica de Cataluña*, a company which is using twenty-four natural lakes at a height of 2,800 feet. Next in order to the Capdellá fall are the Somiedo, Ovideo, fall, 1,800 feet; Caralp, Gerona, falls, 1,550 feet; Puente Marin, Pamplona, falls, 1,350 feet; and the Seba, Santander, river's fall, exploited by *Fuerzas Motrices del Gandara*, with 1,190 feet of useful height.

The great Central Stations are thermic, and some (that of San Adrian, in Barcelona, for instance) contain up to 40,000 H.P. In almost every case steam turbines of 500 to 2,000 H.P. are used. In reserve stations of medium and small power gas engines are in great use; it has not been possible to introduce in Spain the Diesel engine, which is so suitable for this purpose, because heavy oils are not produced in the country and heavy duties are imposed on the importation of this commodity.

Capitals invested in electrical undertakings in Spain amount to about £60,000,000. There are only six companies with a capital not under £800,000 in shares and debentures. The Barcelona Traction Light and Power, whose headquarters are in Toronto, Canada, has a capital of about £6,500,000; *Energía Eléctrica de Cataluña*, £2,000,000; the *Unión Eléctrica Madrileña*, £1,680,000; the *Hidro-Eléctrica Ibérica*, £1,080,000; and £800,000 the *Hidro-Eléctrica Española*. Companies of £80,000 to £400,000 are in a great number, being practically all limited companies (*Sociedades anónimas*). Plants of small power generally belong to individuals or private companies (*Sociedades en comandita*).

ELECTRIC POWER.

The principal use of power was at first limited to lighting, but, a short time after, small-power engines began to be extensively used, and now both small and large industries give preference to electric power, which accounts for the enormous and ever-increasing consumption. The principal industries which use electric power are the textile manufactories, the flour mills, paper mills, cement manufactories (which, by the way, produce 400,000 tons per annum), and the mining companies. Some of these institutions have their own fall, as is the case with the *Compañía General de Asfaltos y Portland* of Barcelona; *Compañía de Cementos Cangrejo*, Navarra; *Sociedad Anónima Portland Iberia; La Vasco-Belga*, paper mill of Rentería, Guipúzcoa; The Alquife Mines and Railway Co., Ltd., which exploits the Alquife mine, Granada, etc.

ELECTRIC TRACTION.

The first railway line electrified was that between Barcelona and Sarriá, in the year 1906. The width of the track was 5·5 ft., but reduced to 4·6 ft., direct current being used at 600 volts. This line was, in fact, a suburban railway 3·2 miles long, but to-day is being extended to Sabadell and Manresa.

Next came the electric railway of Pamplona-Sangüesa, 33 miles in length, with

single-phase motors on the carriages (6,000 volts). This railway, as that of San Sebastian to the French frontier (Hendaya), is 3·28 ft. in width, 12 miles in length, and uses single-phase current.

There are in Spain two traction plants with three-phase current, the first being one of about 14 miles from Gergal to Santa Fe, on the route of Linares-Almeria, which is in the hands of the *Compañía de ferrocarriles del Sur de España*, and the second the train-road (not yet completely electrified) of Ríotinto, 28 miles long.

In the latter, electric power is used as three-phase current at 6,000 volts and 25 periods collected by electric locomotives towing mineral and goods trains. This applies to 14 miles of the line, where the profile is a gradient with a constant declivity of 22/1000 to 28/1000.

The result has been so satisfactory that a petition has been made to extend the electric section up to Almeria, an additional 12 miles. In course of electrification, also by three-phase current, are the 5 miles of Canfranc's tunnel, in the international line of the same name, which it is expected will be inaugurated next year.

Apart from these, there are many lines, all direct current, 500 to 550 volts, called electric railways, but which are in fact street or suburban tramways, *viz.*, Barcelona, Bilboa, Cadix, Cartagena, Granada, Gijon, San Sebastian, La Corunna, Madrid, Malaga, Palma de Mallorca, Seville, Santander, Valencia, Vigo, Valladolid and Saragossa which have adopted urban electric traction. There are also in Spain many suburban lines, some very important because of their length :—

- Bilboa to Durango and Arratia, 28 miles.
- San Sebastian to Tolosa, 15 miles.
- Cadix to San Fernando and La Carraca, 12 miles.
- Bilboa to Las Arenas and Algorta, 10 miles.
- Bilboa to Portugalete and Santurce, 9 miles.
- Valencia to Silla, 8 miles.
- Granada to Santa Fe, 8 miles.
- Barcelona to Badalona and Mongat, 8 miles.
- Cuatro Caminos to Ciudad Lineal-Ventas (Madrid), 7¾ miles.
- Valencia to Puebla de Farnallas, 7½ miles.
- Puerto Chico to El Astillero, Santander, 7½ miles.
- San Sebastian to Hernani, 7½ miles.
- Linares to Las Minas, 7 miles, etc.

The total length of the electric tramway system in Spain is already more than 465 miles.

There are also four electric cable railways and two overhead lines. The former are those of El Tibidabo and Vallvidriera in Barcelona, having a length of 3,800 and 2,400 feet respectively, and the two of Monte Igueldo, San Sebastian, of 1,180 feet, and Archanda, Bilboa, 2,450 feet. The overhead lines are: Monte Ulía, San Sebastian, with one escalator of 1,300 feet, and the suspended car line of Tibidabo, in Barcelona, of 1,500 feet.

AVERAGE PRICE OF POWER IN SPAIN.

The average price of the electric H.P. in Spain is to-day about £7 per annum for important contracts. The lowest price is about £3 10s. H.P. per year of sixteen daily hours, also for large contracts.

The price of kilowatt-hour for motors, tramways, etc., etc., oscillates betewen 0·57d. and 2·85d., being generally about 0·95d. for large quantities and 1·9d. for fairly good consumptions. The average price of energy for lighting is 5·7d. per kilowatt-hour and the maximum 9·5d.; when not charged by meter, a rate of between 1s. 7d. and 2s. 4d. per month per ten c.p. lamp is made. A charge is also made by the State and the municipalities of 23 per cent. of the cost of consumption.

ELECTRO-CHEMICAL AND ELECTRO-METALLURGICAL INDUSTRIES.

With the exception of the manufacture of carbide of calcium, no other electro-chemical industry has been properly developed in Spain. There are thirteen manufactories of this product with a yearly output of 15,000 tons, which quantity is already in excess of the national consumption. Of these factories six are established in Catalunna, three in Aragon, two in Galicia, one in Andalucia, one in Albacete and one in Santander; and in spite of their having had recourse to "syndication" (or being formed into a syndicate) they can hardly maintain themselves.

Besides this, there are two factories devoted to the electrolytic decomposition of common salt from chlorine and caustic soda, by the Grieshein-Elektron process. These establishments belong to the *Electro-Quimica de Flix* in Tarragona and the *Electra del Besaya*, Santander, producing together 10,000 tons per

annum of calcium chloride and possessing their own falls of 2,100 H.P. and 2,000 H.P. respectively. The *S.A. Electroquímica de Finana* produces also caustic soda in its works at Almeria, using her own fall of 600 H.P.

Nothing important has yet been undertaken in the electro-metallurgical field, except the installation of two electric furnaces of small capacity, in Araya, Vitoria, and the electrolytic copper refinery of Lugones, belonging to the *Sociedad Industrial Asturiana.* However, the *Sociedad Altos Hornos de Vizcaya,* a very powerful company, is building an electric arc furnace to produce special high-grade steel, in whose composition may enter several alloys, such as chrome, nickel, tungsten and other components.

In this respect, it is also well worth noticing that a company with £480,000 capital has been formed under the name of *Sociedad Ibérica del Azoe,* and a splendid 25,000 H.P. plant has been erected in Lerida for the production of nitrates, fixing the atmospherical nitrogen by means of the electric arc, according to the patents of the *Sociedad Noruega del Azoe* (The Norwegian Nitrogen Company). It is intended to use the nitrogenous products as fertilizers for agriculture and as raw materials for the manufacture of explosives and gunpowder. The *Banco de Castilla* (Castillian Bank) and the unfortunate founder of *La Canadiense* (The Canadian Co.), Dr. Pearson, were the originators of this undertaking, which, owing to the war, has not been able to start its work.

There is nothing worth mentioning as regards the application of electricity to agriculture in Spain, where everything in this line is in an experimental stage. There is, however, an installation in the province of Huesca to work by means of electricity about 5,000 acres of cereal cultivation.

MANUFACTURE OF ELECTRICAL MATERIAL.

Manufactories of electric material, for which this country still depends to a large extent on other nations, are being established somewhat slowly in Spain. In 1892 the *Sociedad Industria Eléctrica* was established in Barcelona, devoted to the manufacture of heavy machinery, and in 1897 the same was joined to the Spanish Siemens-Schuckert, forming together the *Sociedad Anónima Siemens Schuckert-Industria Eléctrica,* with a capital of £180,000. The headquarters of this company are in Madrid, and the works in Cornellá, Barcelona, producing machines and apparatus for electricity works, for small and large industries, and equipments for tramways, cranes, lifts, ships, and motors and apparatus for blast furnaces, etc.

Other less important manufactories also build dynamos, motors, transformers and heavy material; some of these are *La Electricidad,* Sabadell; *La Electra Industrial,* Tarrasa; *Javier García,* Saragossa. The *Anglo-Española de Electricidad* and many others are devoted to the mauufacture of small material.

The *Sociedad Española del Acumulador Tudor* (The Spanish Tudor's Accumulator Co.), with headquarters in Madrid and works in Saragossa, satisfies the total needs of Spain, supplying Tudor batteries, of which 90,000 H.P. are already in use. The *Compañia de Carbones Eléctricos* (manufacturing electric carbons), established in Barcelona and having its works in San Vicente de Castellet, produces, besides carbons, electrodes, brushes and crucibles.

At the head of the manufactories of cables for electric plants is the one established in 1900 in Villanueva and Geltrú, Barcelona, by the *Sociedad Pirelli & Cía.,* closely related to the company of the same name in Milan (Italy). This splendid organization produces cables for transmission and power distribution, submarine and telephone cables, etc., etc., for every purpose. Much more modest are the manufactories of *Albó & Cía.,* Barcelona; *Montilla Hermanos,* Málaga; and *Cables Eléctricos, Algorta,* Bilboa, which firms produce wires, protected cords and cables for small plants.

As to incandescent lamps, there are at present eight firms devoted to this branch, the oldest of them being the *Compañia General Española de Electricidad,* established twenty years ago. Of the above companies, three are in Madrid, four in Barcelona and one in Valencia, their output being at present quite sufficient to supply the national market, and in a very short time there will be no need to import three or four million lamps annually from Germany and Holland, as at present. Until recent date, local manufacturers used to purchase their filaments from France and Germany, but now factories are being erected to produce them in Madrid.

The production of insulators has reached its highest degree of perfection in the works of the *Sociedad Luis Berenguer,* Barcelona, where

insulators to resist the highest tensions used in modern transmissions may be obtained. The *Sociedad Falcó & Co.*, Valdemorillo, Madrid, and *Bernardo Nalda*, Valencia, also produce insulators for the usual requirements.

Two companies manufacture electric meters in Spain, namely, *Sociedad del Vatímetro B y B*, and *Chamond & Triana*.

And finally, the companies which follow are, amongst many others, manufacturers of gas engines, turbines, steam engines, pumps, and the like, restricting more and more every year the sale of the European and American electrical machines and material imported into this country, namely, *Maquinista Terreste y Marítima*, Barcelona ; *Corcho e hijos*, Santander ; *García & Cía.*, Bilbao ; *Talleres de San Martín*, Santander ; *Metalúrgica Aragonesa y Amorós*, Saragossa, etc.

REMARKS ON THE PRESENT AND FUTURE OF THE ELECTRICAL INDUSTRIES IN SPAIN.

The foregoing pages show clearly that electrical applications generally have reached in Spain a high degree of development, and also that there is a great deal to be done in several of its branches.

As regards lighting, it seems that we have reached the limit, for even the most humble towns use electric power, there being not a few who have changed from the typical old oil-lamp to the metallic filament electric lamp.

In its application to industry, a great deal has been done, the electric motor of from ½ H.P. to 100 H.P. being so largely used that there are very few requiring such power who use steam ; but in the great industries the transformation is somewhat slow and there still exist many who will have to supplant their steam or gas engines by electric motors. In this respect, a great field is open to national and even foreign firms who sell electrical material in Spain, as the national production of this latter is neither sufficient in quantity nor in quality.

Electric traction has a great future, especially in inter-urban lines and in mining centres.

Owing to the heavy expenses incurred in the transformation, it is very doubtful whether the electrification of the great lines will be realized for some time to come. However, the problem is less difficult in new lines or in some railways of narrow gauge, where there is sufficient traffic. Such is the case with the line of San Sebastian to Bilboa (70 miles), which is of one metre in width, and is in a region rich in falls ; for this and other reasons electrification is under consideration. There is also another scheme for a direct railway from the French frontier to Madrid through Burgos and Soria, and its extension to Algeciras and Gibraltar, using electric traction ; the same applies to the direct railway Madrid-Valencia.

On the other hand, the creation of new industries, which from the beginning of the century has been constantly taking place in Spain, and the development of the mining industry require an ever-increasing quantity of electric power, which, thanks to the country's abundance of water and to the considerable increase in the transmission distance, may be supplied at a moderate price, a requisite without which such progress as the statistics so eloquently show would not be possible.

And if the available 5,000,000 hydraulic H.P. were not enough, large plants are already being erected close to the mines for burning coal residues, transforming the same into electric power to be transmitted to the industrial centres. The *Compañía Minera y Metalúrgica de Peñarroya* affords a good example, as it is building two large works in its mines of Puertollano and Peñarroya, with a capacity of 20,000 and 12,000 H.P. respectively, both fed with coal, to supply power to the new railway from Puertollano to Córdoba, now being built, as well as to other mining companies of the zone of Linares and La Carolina.

The impulse that metallurgy has been recently receiving ; the abundance of raw material and water ; the definite proposal to build within a short time, with the help of the State ; the secondary and strategic railway system, the length of which will be 6,500 miles ; the large number of mines where work is done in a rudimentary manner, and many other conditions indicate an ample field in the very near future for the application of electricity in Spain, especially in mining and in those branches connected with electro-metallurgy and electro-chemistry which are still very little developed.

Madrid, 28th June, 1916.

THE RELATIONS OF EMPLOYERS AND EMPLOYED. BY DR. ARTHUR SHADWELL.

The first and most essential condition for the prosperity and progress of industry after the war is peace between employers and employed. That is a truism which everyone must admit, for strife puts a stop to industry in proportion to its range and intensity, and automatically nullifies all efforts and schemes for development. They all assume that industry is carried on; if it is not they have no chance of realization. The air is full of schemes for promoting industrial activity in new directions and making good the deficiencies revealed by the war. We have pressed upon us educational reform, scientific research, financial help, Government aid and encouragement, new fiscal treaties, the development of Imperial resources, modern equipment and methods in the workshop, physical care of the workers and so on. But the prevention of industrial strife obviously takes precedence of them all. Yet it has not until recently attracted any attention, and is even now much less discussed than the application of science or the imposition of duties to protect young industries.

I suppose the reason is either that people do not consider the danger of industrial war very serious, or they look beyond it as a temporary difficulty. In a sense the latter view is correct. Industrial war, like real war, is temporary; it alternates with periods of peace and we ought to look forward beyond it. But it may have permanent consequences, as real war has; and in the present case it would. The period immediately following the cessation of war will be crucial for the future of industry. If any large groups suspend their activity then and waste their strength in an internal quarrel, they will miss the critical opportunity and will lose ground that cannot be regained. Reforms and improvements may be inaugurated later, but their scope and efficacy will be lessened in proportion to the ground lost. Consequently the temporary character of any industrial strife that may arise is not a valid reason for ignoring the danger or passing lightly over it. The real question is—how great is the danger? I propose to answer it and discuss the causes and prevention of strife, so far as space will allow, from the point of view of a disinterested observer who has studied these matters at first hand for many years, and is, to a certain extent, behind the scenes on both sides, but represents neither. I represent the third party, who is usually ignored; and that is the general public, whose interests outweigh either.

Let me say at once that in my opinion the danger is exceedingly great and that it cannot be averted unless it is fully recognised and effective steps are taken to meet it. Those who are behind the scenes need no arguments to convince them that there are solid grounds for this opinion; but it is necessary to set out the case in some detail in order to convince others and to lead up to the question of prevention, which cannot be usefully discussed without examining the actual conditions to be dealt with.

The first point to be noted is the background of the past, out of which certain important elements in the problem arise. The public memory is very short, but neither employers nor employed are likely to have forgotten the period before the war. The three years 1911-12-13 were a time of good trade, following on a longer spell of severe depression. They were also a time of "labour unrest," which is a journalistic expression meaning demands for higher wages and other changes in conditions, with strikes to enforce them. Such demands are always and legitimately made in prosperous periods. The workmen naturally wish to share the prosperity, and if the demand is refused they go on strike. But in the three years before the war this process was carried on with unprecedented vigour. Strikes were more numerous and on a larger scale than ever before. The main reason for this was the growth of Trade Unionism, accompanied by the consolidation of sectional interests by federation. The classical example is the Miners' Federation, which made possible the national strike and total suspension of coal mining in 1912.

But there were other features besides the unprecedented scale of strikes. During the last thirty years theories about the constitution of society, commonly called Socialism, have gradually gained ground, as a younger generation of workmen, better educated and more intellectually alert, have grown up. These theories, promising a new and ideal society, naturally appeal to young and ardent minds, and they necessarily introduce an irreconcilable

element, because they condemn the whole existing order and are even more hostile to good than to bad relations between employers and employed, because the aim is to get rid of those relations altogether and harmony is the greatest possible obstacle to its realization. The hope lies in perpetual antagonism, which is assiduously fostered. Further than that, however, a new theory made its appearance in the stormy period before the war, which directly counsels violence as the means of overthrowing the existing order instead of the political methods favoured by Socialism. It was not really new, but it originally appeared so long ago that it had been forgotten, and it had a new name—Syndicalism. Its policy is "direct action," which means strikes and other hostile measures against employers constantly applied. This makes a strong appeal, because it is in harmony with Trade Unionism and promises more speedy results than political Socialism, which has been tried and found barren. In the background are other theories or isms, which are variants and need not be specified. The advocates of all these theories compete with each other for the support of the Trade Unions with varying degrees of success, which we need not attempt to estimate. The success is local, partial and numerically small, but the combined effect is to fan discontent, stimulate industrial strife and foster an irreconcilable spirit. The theorists form a ferment which is always at work leavening the mass. In addition to this general influence the doctrine of Syndicalism, which has a strong infusion of Anarchist blood in its veins (if one may use the metaphor), tends in a marked degree to accentuate the weakening of authority and loss of control in the Trade Unions, which have been a prominent feature of their development in recent years. The rank and file have always been liable to get out of hand on occasion, but since the passing of the Trade Disputes Act in 1906 control has been slipping more and more from the hands of the "leaders," until their position has become pitiable. In some very important branches of industry they have much less trouble in dealing with employers than with their own unruly members, whom they only lead by following.

Such were the chief factors in the situation on the labour side in the period before the war. And what did the employers do? In many cases they did the worst possible thing. They adopted the immoral and disastrous policy of first refusing demands which they could easily afford to concede and then giving way when the men went on strike. The ship-owners began it in 1911 under the fatal lead of the Shipping Federation. They declined to make advances which they ought to have made to the seamen and firemen, and derided the threat of a strike until it occurred, when they immediately fell down one after another like a row of nine-pins. This let loose the flood-gates. The effect was to justify strong action and play into the hands of the theorists, the agitators and the more violent sections among the Trade Unionists. It proved them right in the eyes of all. That is always the effect of this false policy, which is precisely the reverse of the attitude that employers should adapt. It is mean, grasping and cowardly. How on earth can men have any confidence in the intentions or in the word of employers who grudge them any share in their own prosperity, who say they cannot afford what they immediately do afford, and who yield to force what they refuse to goodwill? This behaviour is justified as "business" and proper to the "shrewd hard-headed man of affairs." It is a fool's business. And the worst of it is that one fool can undo the work of a hundred wise men. All employers do not take this line any more than all workmen have embraced an extravagant theory and desire a social revolution. On the contrary, the great majority on both sides are reasonable men who prefer conciliation to strife and are willing to settle relations by taking counsel together. The growing adoption of this procedure in recent years must be set against the influences, just mentioned, that make for strife. But a comparatively small number of business fools on one side and social theory fools on the other can counteract the efforts of a much larger body of sensible men on both sides. And that is what happened.

The nett result of the 1911-13 turmoil was a state of truce produced in one industry after another by concessions which left the recipients unsatisfied and many at least of the givers irritated. At the same time it stimulated the growth of Trade Unionism and the tendency towards more powerful combinations, but also more indiscipline. In these circumstances the renewal of conflict was certain when the period of prosperity came to an end and gave place to

depression. Both sides were, in fact, expecting it and preparing for it, I do not say in all industries, but in some of the largest and most important branches. The feeling varied widely in different localities, and it was most acute where the hard-headed business man and the social theorist—who are the pugnacious elements and stimulate each other—were strongest. The strife that would have ensued would have been far more determined and embittered than in the preceding period, because it would have occurred on a falling market. Employers would have insisted on reductions of wages which would have been resisted to the uttermost, and then they would have closed down altogether. They were, in fact, contemplating it in some highly influential quarters, to my certain knowledge.

Such was the atmosphere and such the prospects when the war broke out. The decline of trade had begun and we were advancing towards that state of conflict indicated. War immediately changed the whole situation. The Trade Union leaders, partly from patriotic motives, partly from fear of general unemployment and a great drain on their funds, called off all disputes and, broadly speaking, with success. For six months trade disputes fell to insignificant proportions. That was the first phase. Meanwhile the authorities were gradually realizing the character of the new warfare and the unlimited demands which it makes on industry. With the progress of this enlightenment, and under pressure of urgent military needs, came a continually growing demand for labour, competition for men at any price to fulfil contracts given out at any price. Hence rising rates of wages and earnings inflated by overtime to heights never dreamed of before. Unemployment disappeared, women, girls and, boys were called in to do men's work and so enabled to increase the family income.

There is no need to pursue the story of war industry, which has gone on continuously developing ever since. It is too fresh in everyone's mind. Suffice it to say that the whole economic situation was changed, and with it the relations between employers and employed, which have been modified in essential particulars by legislation and Government control. What I wish to point out is that these changes have not brought any improvement in spirit which might counteract the forces making for strife before the war and indicated above. They have had the contrary effect; they have increased friction, irritation and distrust, and at the same time they have multiplied the possible occasions of future strife to an enormous extent by adding to the old differences new and more critical ones.

Persons only acquainted with the surface of things or with conditions in favoured areas may be inclined to question the accuracy of this diagnosis. They will—and already do—call it "gloomy," "pessimistic" and so forth. They point to the cordial assent of Trade Unions to the suspension of their rules, the immense effort in the workshops, the comparative infrequency of strikes and the harmonious co-operation of employers and employed. They are deceived by appearances. Mutual antagonism has been damped down; but it is seething underneath the surface, and is so strong that all the needs of war, all the compulsion of Government, all the efforts of official Trade Unionism and all the machinery of conciliation have failed to prevent it from boiling over more often than the Press Bureau allows to be known. The supposed suspension of Trade Union restrictions has only taken effect to a limited extent, and it has been—and still is—constantly resisted. It is grudgingly and sullenly accepted; the cordial assent is a newspaper or political myth. If this is the case in war, when every inducement to increase output is present, what are the prospects hereafter, when manufacturers have to seek orders in a competitive market, and the bar on overt conflict is removed? Nobody with an inside knowledge of the circumstances will belittle the danger. To do so is to indulge in the same fatuous "optimism" as that which led the nation unprepared into war.

It is not possible within a limited space to go into all the points involved. It must suffice to mention the more important ones. These are the Trade Union restrictions and the employment of women. With regard to the first, it appears from the proceedings at the Trades Union Congress and from other signs that the Unions are resolutely determined to insist on the full restoration of all practices which have been abandoned or modified on account of the war. If they do the immediate result will be that innumerable difficulties and differences will arise which can only be settled by arbitration, if at all. The changes have been very imperfectly recorded, as Mr. Mosses pointed

out at the Congress, and there is no code of rules for reference. Great misapprehension prevails about these so-called rules. They are supposed to have been "built up" with infinite pains into a solid and authoritative code. I know the expression, because it is my own. I applied it to Trade Unions in my book on "Industrial Efficiency," but what I pointed out was that the Unions have been built up with infinite pains and labour. The rules are a different matter. Some of the most important and most jealously maintained are not rules at all, but workshop practices, unwritten, undefined and varied at will. No human being knows what they are because they vary indefinitely not only from one district to another in the same trade, but from one works to another in the same district, and from one shop to another in the same works. The men know the rules in their own shop for the time being, but that is all. And the rules undergo incessant alteration through the introduction of new processes and plant. Now a great number of new processes, for which there were no rules, have been introduced during the war; and there will be a great many more when the works engaged on war production revert to commercial purposes, for which much of the new machinery will be utilized. Old industries will be transformed and new ones added.

It is obvious that endless disputes must arise on the attempted application of the old rules and practices to new conditions. The transformation which many branches of industry have undergone was foreseen by no one, and with the best will in the world a return to old arrangements is not possible, because the physical conditions are changed.

But there is more than that. Where the "dilution of labour" has been methodically carried out, it has involved the detailed investigation of workshop practices, and the result has astonished everybody concerned. An intricate system has been revealed, the effect, if not the object, of which is to secure a maximum degree of inefficiency and the smallest possible output from the means available. Nobody seems to have realized how far this system of calculated inefficiency went until the problem of re-organizing the workshops with a view to making the most of the means available was seriously tackled. The result is a revelation. The art of how not to do it had been brought to a state of perfection. That this is no exaggeration is proved by the fact that the rate of production has been trebled by re-arrangement, even with inferior labour. What chance of surviving in the international market will British industry have in the future if the principle of maximum inefficiency is maintained?

The second point mentioned above as a source of danger is the employment of women. It is popularly known that women have revealed an unsuspected capacity for many forms of work they have never attempted before, and for once popular knowledge is correct. So far from being overstated, the accounts of feminine capacity fall short of the truth. There is no process they cannot master except those involving the exercise of great muscular strength or exposure to extreme heat and severe weather. From automatic lathes they have gone on to machines of every kind, hand tools, pneumatic and electric plant and all sorts of miscellaneous operations; and some are at this moment filling responsible positions requiring great care and accuracy. It is the revelation of a latent fund of industrial strength, the value of which can hardly be estimated. Is it all to be thrown away? Of course a large number of the women now at work will not want to continue; they are meeting a temporary emergency which will pass. But the discovery of their capacity cannot be erased or suppressed, and some will insist on being allowed to fulfil functions for which they have been found admirably fitted and to exercise abilities they are conscious of possessing.

It is not necessary to labour the case further. Surely it is obvious that the occasions of strife have been multiplied many times over and that if the old spirit prevails there is no chance whatever of finding a way through them. Several other conditions, into which I will not enter, combine to make the prospect still darker. Nothing but a bold new departure, undertaken in a new spirit with conscious purpose and resolution, can avert an outbreak of fierce, determined and ruinous strife, not in every industry, but in more than enough to paralyze the national life. The only hope lies in the suppression of the pugnacious element on both sides by the united action of the great mass of reasonable and fairminded men on both sides. They must do it themselves; the Government cannot do it, for politicians and Government departments—and particularly the chief officials

of the Board of Trade Labour Department—are equally distrusted and disliked by both sides. It is for the employers to give the lead. An absolutely indispensable condition for future peace is the suppression of the bad employer, by which I mean anyone who deals with labour in a grasping or a bullying spirit. He is the man on whom the agitator lives. A second indispensable condition on the other side is that Trade Unions shall possess and exercise real authority and control over their members.

ENGINEERING INDUSTRY: LARGE MEETING AT THE MANSION HOUSE.

Following the series of meetings held in the spring in Birmingham, Manchester, Newcastle, Glasgow and Liverpool, a gathering of a representative national character took place on Sept. 20th in London.

Lengthy summaries appeared in the daily press, and the character of the meeting is well described in the opening paragraph of the *Daily Telegraph* report :—

When peace comes one of the great problems will be the utilization to the fullest extent of this country's enormous engineering capacities, which the demands of war have developed to a prodigious degree. This formed the keynote of a great meeting held at the Mansion House yesterday afternoon, under the presidency of the Lord Mayor (Sir Charles Wakefield), to discuss trade policy after the war, with special reference to the engineering industry.

It was organized by the British Electrical and Allied Manufacturers' Association, with the co-operation of the British Engineers' Association, the British Empire Producers' Organization, and the engineering and electrical sections of the London Chamber of Commerce. The general attendance bore further testimony to the thoroughly representative character of the meeting, the presidents of the great engineering institutions and members or officials of Government departments being present, besides members of Parliament and representatives of municipal and other authorities and of various trading companies. There were also well-known scientists like Sir William Crookes and Sir Oliver Lodge. Mr. Balfour, who had hoped to attend the meeting, wrote to express his great regret that it was not possible owing to an important conference at the Admiralty.

As a verbatim report will be issued, probably before this journal is published, it is not necessary here to give more than a general impression of the telling effect and enthusiasm of the meeting, at which over 800 were present. It was remarked by Mr. C. P. Sparks that this was the first time that engineering had had the honour of special recognition in the City of London. The B.E.A.M.A. has carried out a friendly invasion of territory hitherto observing a benevolent neutrality. The Lord Mayor himself is, of course, well acquainted with the industry, and we were fortunate in having the meeting held under such favourable auspices. The Lord Mayor of Manchester also brought very influential support to the claims of the industry as representing our greatest machinery market. A deep impression was created by the eloquent appeal of Mr. G. H. Roberts, as a Labour member of the Government, that we should use the present time of national unity to settle all our minor differences.

The *Morning Post* of the following Friday, Sept. 22nd, devoted its first leading article to the meeting under the heading "Do It Now," from which we quote the commencing passage :—

Welcome evidence of the new spirit that is stirring in our industrial world was afforded by the highly important meeting, representative of the engineering and allied trades, that was held at the Mansion House on Wednesday, under the chairmanship of the Lord Mayor. Our engineering industry is fundamental to our whole industrial prosperity. To-day it is, as the Lord Mayor stated, without exaggeration, "the main bulwark of British liberty"; and no scheme of reconstruction after the war can be successful which does not secure "the vigorous economic development of the engineering industry." We have, indeed, encouraged our competitors—and competitors only biding their time to become enemies—long enough out of regard for an outworn doctrine and for interests which were not national but particular. What we have to do now, in regard to engineering and other prime industries, is to take care that the disastrous conditions which were allowed to establish themselves before the war shall not return, but that production, on which all sound prosperity is built, shall be the first care of policy. Our capacity for production has been demonstrated by the accident of war in a manner that has dissipated a good many confident theories and assumptions. It has been demonstrated just as clearly as the danger of the humiliating dependence to which we had been content to be reduced; and, while the nation has been aroused from lethargy and illusion, the producers themselves, both employers and workmen, are—unless all the omens mislead—seriously setting themselves to devise the measures necessary for perpetuating after the war the enhanced capacity which has been discovered during the war.

The full list of speakers and the important resolutions carried were as follow :—

1. The Rt. Hon. The Lord Mayor moved:

That this Meeting expresses its appreciation of the great national service rendered by the munition workers of the country, whose patriotic support of our fighting forces on land and sea is hastening the achieve-

ment of final victory, and expresses the hope that permanent remunerative employment will be secured in the vigorous economic development of the engineering industry after the war.

2. Mr. Alderman and Sheriff G. A. Touche, M.P., seconded the resolution.

3. Mr. G. H. Roberts, M.P. (Lord Commissioner of the Treasury), supported.

4. The Rt. Hon. The Lord Mayor of Manchester moved:

That the indispensable military service rendered by the engineering industry, and its fundamental importance in the future as the basis of defensive power and of prosperous economic development, entitle it to special recognition in any reform of a national and imperial commercial policy, and to the patriotic support of all public and private users of plant and machinery throughout the Empire.

5. Mr. C. Sandbach Parker (Chairman, British Empire Producers' Organization) seconded.

6. Sir Oliver Lodge, F.R.S., supported.

7. Mr. W. Wilfrid Stokes (Chairman, British Engineers' Association) moved:

That this Meeting expresses its general approval of the proposals of the Paris Economic Conference, and recommends that their practical application for the benefit of British Industry should be furthered by the immediate appointment of a Ministry of Industry.

8. In the absence of Mr. Herbert B. Rowell (President, North East Coast Institution of Engineers and Shipbuilders), prevented from attending by a sudden bereavement, Mr. T. C. Elder formally seconded on his behalf.

9. Mr. George Terrell, M.P. (British Electrical and Allied Manufacturers' Association) moved a vote of thanks to The Lord Mayor of London for the hospitality of the Mansion House and for presiding.

10. Mr. C. P. Sparks (President, Institution of Electrical Engineers) seconded.

The Rt. Hon. A. J. Balfour, M.P., who had hoped to come to the meeting, wrote to express his great regret that it was not possible for him to attend owing to an important conference at the Admiralty.

Amongst the audience were representative members or officials of

The Ministry of Munitions,
The Board of Trade,
The Foreign Trade Department,
The Metropolitan Munitions Committee,
Institution of Civil Engineers.
Institution of Mechanical Engineers.
Institution of Electrical Engineers.
North-East Coast Institution of Engineers and Shipbuilders,
Society of Chemical Industry,
Association of British Motor and Aircraft Manufacturers,
Institute of Metals,
Manchester Chamber of Commerce,
Institution of Sanitary Engineers,
Society of British Gas Industries.
The Engineers' Club, Manchester,
Sulphate of Ammonia Association,
Institution of Automobile Engineers,
Imperial College of Science and Technology,
University College,
Sir John Cass Technical Institute,
British Association of Trade and Technical Journals,
Tramways and Light Railways Association,
Association of Electric Power Companies,
British Workers' National League,
University of Birmingham,
Incorporated Municipal Electrical Association,

besides many municipal authorities, railway and shipping companies, electric power and traction undertakings, and manufacturing companies from all over the country.

The following interesting letter was received by Mr. T. C. Elder, organizer of the meeting on behalf of the B.E.A.M.A., from Viscount Milner:—

Many thanks for sending me the platform ticket for the meeting on Sept. 20th. As I have already told you, I have engagements that day which prevent my attending, but I am particularly sorry that I cannot come, in view of the statement of the objects of the meeting, as explained in the little printed memorandum which you send me. I entirely agree with the views therein expressed.

The great economic problem before us, as I see it, is whether the enormous expenditure now being incurred for increased means of production can be turned to account in peace as well as in war. It has been truly said that the only thing which will enable us to carry the enormous burden of debt at present being created, is a great increase of production. In order to pay our way, we must be able to produce and sell a much greater quantity of goods. The enormous outlay upon additional plant made during the war *ought* to enable us to do this. If it does, we shall have a substantial *quid pro quo* for a great part at least of our present expenditure, and the future will look much brighter. The solution of the problem seems to lie mainly in two directions:—

(1) The reorganization of our great staple industries, including agriculture, to meet the new conditions.

(2) A concordat between Capital and Labour, which, difficult as it is, seems to be more attainable under present conditions, when the views of both parties have been so greatly widened by the teachings of experience, than ever before.

As your meeting seems to be directed to the promotion of both these great objects, it certainly ought to be a very useful one, and an important step in the right direction. I heartily wish it success.

THE MECHANICAL MARGIN: THE INFLUENCE OF INCREASED PRODUCTION IN THE SOLUTION OF THE PROBLEMS OF PEACE. By T. C. ELDER.

The losses of war may be reckoned in men, time or material. For two years now, and perhaps for a third year, Europe has turned aside from the production and enjoyment of wealth to the making and the handling of instruments of destruction. Plentiful munitions must mean scarcity and dearness of most other things. We ought, therefore, on balance, to be much poorer, as a continent, since so many millions of men have produced nothing for us, since so many million hours of their time have been devoted to digging holes in the ground and filling them up again, since so many million tons of valuable metals and other materials have been shaped laboriously into ammunition and then methodically blown to bits.

So much is a mere commonplace restatement of the economic position. The next stage is more subtle and evasive. It would appear that we have our choice between two types of prophets, both unable to produce much in the shape of qualifications; those who tell us respectively that it will be fifty or a hundred years before we cease to feel the pinch, and those who assure us that we shall be rolling in luxury again within five or ten years, if indeed we do not find things actually booming from the very day of peace.

I find myself in the camp of these latter optimists—with certain mental reservations. And touching this tremendous many-sided question only on one or two of its facets, I will even dare to give reasons for my beliefs, although that will at once reveal me as but an amateur amongst prophets.

Let us take first the men. We have lost, it is said, so many men for ever, and we have lost the labour of all those still in the field or in hopsital. Like many statements tossed about in public discussion, this commonplace ought to be periodically withdrawn from circulation for minute analytic re-examination. The casualty list is not within my range of reference for the purpose of this essay. I am treating of economic loss; that is to say, the interruption to the output of wealth in the present and the future. And in refusing to be appalled at the mere statement that the labour of forty million men has been withdrawn from our economic service, I prefer to be more impressed by the obvious fact that the greater part of Europe is at least able to live and "carry on" without them. In these forty millions we include merely the fighting men and the munition makers. There are many others, as well as many women, who are in various ways serving the armies and navies. In fact we have now some ten "nations in arms." It is proved to be an economic possibility that this central area of the world's civilization, this busiest site of industrial production, can actually afford to turn over its affairs, for two or three years at least, to the military commanders; can afford that, in the sense that meanwhile it can still get its living. I am not ignoring examples of severe distress in certain corners of Europe, any more than the curious phenomena of hectic prosperity in parts of our own islands. I am striking a broad average, and I am making necessary allowance for the effect of the blockade, which does not so much affect production as it prevents distribution. There is enough for Europe to live on.

All I wish to establish is that a nation can go to war month after month, on this scale of universal service, without an economic collapse, which is something we should have refused to believe two or three years ago. What is the explanation?

The explanation is simple enough. Even the busiest of these nations, ambitious and avaricious, labouring consciously for power and luxury, has, nevertheless, only been working at about 50 per cent. efficiency or less in the past. Germany, for example, so highly organized, so greedily appreciative of all mechanical and chemical innovations, so lustful of world-power, has had this vast margin of productive capacity, so to say, up her sleeve. If she had concentrated all her schemes of organization on economic progress, and dismissed her dreams of military aggrandisement, what might she not have accomplished in the next ten or twenty years? And, as a warning in passing, what may she still not attain, if her neighbours prove complacent and seek their triumphant ease too directly when peace is declared?

That the grown population of any European country have only in the past been working at 50 per cent. efficiency does not signify either that they have idled or made holiday. It means that they have not handled

the means of production with the utmost diligence and intelligence. There has been a large mechanical margin unused. The least efficient person may be one who never stops toiling except for meals and sleep ; and the most efficient may be a brain worker, who seeks frequent relaxation, but who has the power to concentrate his thoughts intensely on the solution of problems of organization or policy, or on the discovery of improvements in machinery. Yet the man with the sweating brow and the spade is, in popular esteem, a more admired figure than the cool chemist in his laboratory.

What happens when half the workers of a nation go to the camps or to the arsenals is that the rest must labour more efficiently. In Britain that has been brought about by an industrial rearrangement which has employed millions of our people more productively than before, removing many women, for example, from the scullery to the factory. Unlike the new soldier, they have passed from work of destruction to work of production.

I am arguing this point not as affecting the past or the present. I think it is clear that our hopes for the future must be based on this margin of efficiency. It ought to be discussed as affecting :—

1. The re-employment of the returning armies.
2. The standard of living.
3. The economy of materials.

Most people seem to have visions of millions of unemployed stalking hungrily in search of wages and threatening violent social disorder. But the question is primarily not so much whether there are jobs awaiting them as whether there is a living. We are keeping them now. We can go on keeping them, if necessary, in gradually decreasing numbers without employing them, except as standing armies. Taking again, however, our round figure of forty millions engaged in one department or another of war work, we are justified in assuming that the world will have more need of them in peaceful employment after than before the war. If all the world's textile workers had been on strike for two years, we should all be going short of clothing, and there would be plenty of orders waiting for the resumption of business. There is no question as to whether the world wants the labour of these millions. If the earth were being cultivated to the limit of its productiveness, if all the mines were being fully worked, if we were overstocked with railways and shipping and telegraphs, if all our cities were so beautiful and all our homes so convenient that we could see no room for improvement, if every citizen of the world were already clothed in bright raiment of everlasting wear, then we might say—and it is the least we could say—there is no work for these forty millions, but they shall be our permanent guests and share all these luxuries. But there is no such satiety. On the contrary, after having for two years had to take what it could get, the world will go back more impatiently to wanting always more than it can buy. The demand for construction and production and service grows all the time with what it feeds on.

The only condition attaching to this great influx of labour is that it shall be efficient. We do not need them as forty million primitive hewers of wood and drawers of water ; but we do need them if they will come and work machinery for all it is worth. For their own sakes, as well as ours, the labour of the returning warrior must be highly productive. This is exactly contrary to the theories held by the more old-fashioned Trade Unionist, although its truth is recognised by the more progressive. The former proceed by dividing and the latter by multiplying ; that is to say, taking, as an illustration, the home boot trade of this country, it is easy to see that if you abolish machinery the present output would employ many more workers ; but the greater cost of handiwork would make the price too dear, so that very shortly, either the whole supply would be imported from America, or many more people would walk barefoot, and presently the ratio of unemployment amongst bootmakers would be very distressing. Just the opposite effect might be expected if, by the introduction of still more efficient machinery, the output per man were multiplied.

All that is required at any time to dispel this nightmare of unemployment is that the nation should encourage the use of its brains and machinery ; its mental and mechanical powers of organization. We can only live on or by what we produce, and the more we produce the better we shall live. It is a good point, now more frequently made, that we must pay for the war by increased production of wealth,

but it is better to start arguing rather from this very significant fact that we have already tremendous powers of production, even while the pick of Europe's male population are engaged in scientific distribution. Do not let us be afraid to come to close quarters with the amazing phenomenon that, as the war goes on, it seems to become in some ways economically easier. We were ourselves much more troubled about these daily millions of expenditure eighteen or twelve months ago. We have become reconciled almost. We admire this Niagara of finance without being any longer appalled. We are able to do that because we find that our reserves of accumulated wealth and credit are greater than we knew, and because we have brought into employment part of a hitherto wasted margin of the physical and mechanical means of production.

If then there is any such problem of peace looming ahead, what it amounts to first of all is surely whether, giving up this temporary staple industry of munition making, we cannot carry on without the returning soldiers and sailors, and maintain a high general standard of living by the labours of those who have not been on the battlefield. That would be no satisfying situation, for obvious reasons, but its contemplation is worth while here. It is another way of reminding ourselves that in the past we have grossly wasted our resources and our labours. We must not be too ready to believe that all these people, who are astonished and sometimes rather unhealthily excited by their wonderful war earnings, are living in a fool's paradise. They will want to see the tap still turned on, and they are surely beginning to see how it can be done: that is to say, repeating our former expression, by working machinery for all it is worth. They are bound to ask themselves why it should only be guns and shells—instruments of destruction—that should be manufactured by intensive methods. Many things for which the world is almost starving might equally well be made amidst the same chorus of patriotic mutual encouragement and the same free flow of currency.

In our time of terrible danger, British engineering has saved the situation. Another abnormal situation of, in some people's opinion, almost equal peril, is certain to follow. My claim is that British engineering can and will and must be made to save that also. The great machine can, as it were, reverse. Instead of destroying it can construct. Instead of dealing out death and disaster, it can give longer and fuller and brighter life to the masses of the people. After having had our engineering industry fed with millions of new capital for the hasty purposes of war, it is quite probable that the best way to prosperous peace is a bold continuation of investment in this field, rendering it still more efficient and productive in proportion to the human effort employed.

The great battleline of economic controversy divides two opposing forces marshalling, on one side, those who know that wealth for everybody can only be attained by intensified production, by the enlistment of every discovery of science and every mechanical improvement, by the continuous reform of organization in the effort to make brains, nerves and muscles more profitable to all classes and to the nation; and on the other side, a very numerous force whose faith lies in the niggardly and grudging employment of economic apparatus; whose honest, but appallingly unsound opinion is that it is better to cramp and confine the productiveness of machinery; whose doctrine amounts, indeed, to a preference for growing one blade of grass instead of two. What they really want is wealth; but what they think they want is work; and for the illusory prospect of continuous employment at only moderate wages they will sacrifice every gift that science dares, with due apologies, to offer.

There are millions of apparently indifferent spectators; but the contestants are these two groups: those who believe that it pays to produce more and those who believe that it pays to produce less. If the party of progress do not prevail, the outlook is gloomy indeed. Three years of war will certainly be followed by thirty years of misery. But it is our duty to fight harder on the side of intelligent availment of the powers offered to us. There exists this vast unused margin of economy and efficiency out of which we can recover our war costs with a handsome surplus. I have tried to show that it was only by encroaching on this margin that we have been able to keep our heads above water while so many millions of Europe's men and women have been making and using the machinery of sudden death. We ought to have been learning the most impressive lesson in practical political economy ever

delivered in modern times. And all who read that lesson aright owe it as a national obligation to give their utmost support to a patient and tactful, but determined campaign for the full enlightenment of the whole community.

It can only end in one way. The State must give security to productive industry. Capital must give security to labour by conceding the principle of "the right to work." Labour in return must give security to Capital by conceding the principle of unrestricted output. Nothing more is needed to ensure that there shall be no problem of unemployment, and that the citizens of this country shall have their full share of the good things of life.

TRADE BANK FOR THE EMPIRE.

Recommendations for the furtherance of British trade and manufactures are made in the report to the President of the Board of Trade by the Committee on Financial Facilities for Trade. The chief point of the report, issued September 22nd, as a White Paper (Cd. 8346, 1d.), is that a "British Trade Bank," constituted under Royal Charter, should be established to fill the gap between the home banks and the Colonial and British-foreign banks and banking houses, and to develop facilities not provided by the present systems. The main features of the Trade Bank should be as follows :—

(I.) It should have a capital of £10,000,000. The first issue should be from £2,500,000 to £5,000,000 upon which in the first instance only a small amount should be paid up, but which should all be called up within a reasonable time. A further issue should be made afterwards, if possible, at a premium.

(II.) It should not accept deposits at call or short notice.

(III.) It should only open current accounts for parties who are proposing to make use of the overseas facilities which it would afford.

(IV.) It should have a Foreign Exchange Department where special facilities might be afforded for dealing with bills in foreign currency.

(V.) It should open a Credit Department for the issue of credits to parties at home and abroad.

(VI.) It should enter into banking agency arrangements with existing Colonial or British-foreign banks, and where such arrangements were made it should undertake not to set up for a specified period its own branches or agencies. It should have power to set up branches or agencies where no British-foreign bank of importance exists.

(VII.) It should inaugurate an Information Bureau.

(VIII.) It should endeavour not to interfere in any business for which existing banks and banking houses now provide facilities, and it should try to promote working transactions on joint account with other banks, and should invite other banks to submit to it new transactions which, owing to length of time, magnitude, or other reasons, they are not prepared to undertake alone.

(IX.) Where desirable, it should co-operate with the merchant and manufacturer and possibly accept risks upon joint account.

(X.) It should become a centre for syndicate operations, availing itself of the special knowledge which it will possess through its Information Bureau.

(XI.) It should receive Government assistance.

The members of the Committee were :—Lord Faringdon (Chairman), Mr. B. P. Blackett, C.B., Sir W. H. Clark, K.C.S.I., C.M.G., Mr. F. Dudley Docker, C.B., Mr. Gaspard Farrer, Mr. W. H. N. Goschen, the Right Hon. F. Huth Jackson, Mr. Walter Leaf, the Hon. A. H. Mills, Mr. J. H. Simpson, Mr. R. V. Vassar-Smith, and the Hon. R. E. Beckett. Mr. Gaspard Farrer did not sign the report.

The Report says :—

We recognise also that the British manufacturer may be frequently in want of finance of a kind which a British Joint Stock Bank with liabilities could not prudently provide, whereas the German banks in particular seem to have been able to afford special assistance at the inception of undertakings of the most varied description, and to have laid themselves out for stimulating their promotion and for carrying them through to a successful completion. We conclude, therefore, that there is ample room for an Institution which, while not interfering unduly with the ordinary business done by the British Joint Stock Banks, by Colonial Banks, and by British-Foreign Banks and Banking Houses, would be able to assist British interests in a manner that is not possible under existing conditions.

COMMERCIAL INFORMATION BUREAU

Such an institution could also take a leading part in the inception of transactions and assist in connection with the machinery of overseas business.

The institution must be equipped with an up-to-date information department, and this will of necessity play a large part in its usefulness and financial success. This might properly be called a Bureau d'Etudes, independent of the Commercial Intelligence Branch of the Board of Trade, but in close touch there with and under agreement entitled to all possible facilities. That such a bureau is essential has been made abundantly clear by the evidence given by witnesses we have heard and also by the evidence

given before other Committees. It would not necessarily deal only with schemes in which the institution proposed to take financial interests, but might be made a centre for investigation of projects on behalf of others, and a considerable revenue might be obtained thereby.

Nearly as important as the board would be the general staff. It is fair to assume that women will in the future take a considerable share in purely clerical work, and this fact will enable the institution to take fuller advantage of the qualifications of its male staff to push its affairs in every quarter of the globe. Youths should not be engaged without a language qualification, and after a few years' training they should be sent abroad. It could probably be arranged that associated banks abroad would agree to employ at each of their principal branches one of the institution's clerks, not necessarily to remain there for an indefinite period, but to get a knowledge of the trade and characteristics of the country. Such clerks might in many cases sever their connection with the banks to which they were appointed and start in business on their own account. They would, however, probably look upon the institution as their ' Alma Mater.' Every endeavour should be made to promote *esprit de corps*, and where exceptional ability is developed, it should be ungrudgingly rewarded. If industry is to be extended, it is essential that British products should be pushed, and manufacturers, merchants and bankers must combine to push them. It is believed that this pushing could be assisted by the creation of a body of business young men in the way above described.

If financial assistance is given by the Government to undertakings in connection with what are known as ' key ' industries, the business should, if possible, be done through the medium of the institution.

In the financial operations of the institution the desirability of assisting British trade and of placing with British manufacturers orders in connection with new undertakings should be always borne in mind.

We are of opinion that there are strong reasons why the bank should be formed without delay, so that preliminaries may be completed before the war is over. We believe that a bank constituted upon the above bases, with efficient management, should not only be a great boon to British trade, but should prove a commercial success.

"CERTAIN great principles of life, such as the principle of self-government, will, as time goes on, become more and more a common inheritance of mankind."

—*The Problem of the Commonwealth.*

ELECTRICAL EQUIPMENT OF TEXTILE MILLS. By JOHN SHAW.

The first Textile Mill in the United Kingdom was equipped with electrical power plant in 1905, and since that date many schemes have been carried through, and considerable experience obtained in the requirements of this branch of industry, with the result that to-day the methods of driving such machinery are fairly well standardized. The results have shown that the claims originally advanced by the advocates of electrical driving have been substantially proved as being correct. These claims are so well known, and at the present time so generally accepted by the textile world that they need not be further detailed here.

Applications of electrical power have been carried through in every branch of the textile industry; among mills equipped are cotton, wool, flax, jute, hemp, silk, lace, etc. (both spinning and weaving), also many finishing mills, where the fabric is finished after it leaves the loom. Broadly speaking, it has been found that the results have shown increased commercial economy throughout these concerns. True, there have been, particularly in the earlier stages, schemes which might be classed as failures, but these have only proved stepping stones to permanent successes at later periods.

Probably the total amount of power now being transmitted electrically in textile mills in the United Kingdom is about 180,000 B.H.P. of motors installed, and the fact that extensions are daily being carried through in mills which have had experience of this method of transmission, proves that the operating advantages have demonstrated themselves to the mill authorities.

The first complete mill driven in this manner was a spinning mill of about 75,000 spindles, its finished product being warp beams and weft cops. The scheme of driving was decided upon before a brick was laid, and all the problems likely to be met with were closely investigated, with the result that the mill structure was slightly modified to suit the ideas prevailing at that time in regard to the use of this power The mill throughout was driven on what is generally known as the group system. Motors were provided for driving the line shafts in the mill, driving similar classes of machinery,

and in all cases where possible the speeds of the shafts were arranged to be such that the motors could be directly connected to them. The speeds of the shafts throughout the mill were somewhat higher than was then usual in similar mills driven by mechanical means of transmission. These shafts were consequently much lighter and the shaft pulleys smaller than would have been the case had the mill been mechanically driven. In view of the high speeds of shafts decided upon, and in order to keep down the weight of shafting throughout the mill, it was decided that, while the main piers of the mill were as usual about 22 ft. pitch, each bay should be divided into three arches, instead of the usual two, thus making the shafting bearings throughout the mill about 7-ft. 4-in. centres, instead of the usual 11-ft. The effect of this was the adoption of very much lighter shafting throughout. It is an interesting feature that the largest shaft in this mill, which requires in all some 1,500 H.P. for driving, is no greater than 3-in. in diameter at the driving end. After ten years' service of this equipment, the same motors as originally installed being still in service, the mill authorities recently placed an order for the complete equipment of their second mill in a similar fashion. This fact speaks for itself as to the economy and reliability of this means of transmission.

There have been many papers read and opinions expressed on this development, both pro and con, and particularly the latter; but

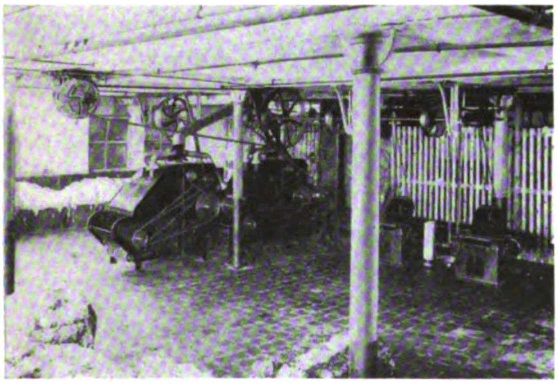


Fig. 1.
MIXING-ROOM, DRIVEN BY INDUCTION MOTOR.

users of this drive have gone on installing more and more, showing that whatever theoretical disadvantages such methods involve, the commercial advantages commend themselves to the producer, and justify his making extensions on these lines.

In the case of cotton spinning mills, which may be taken as typical of the methods

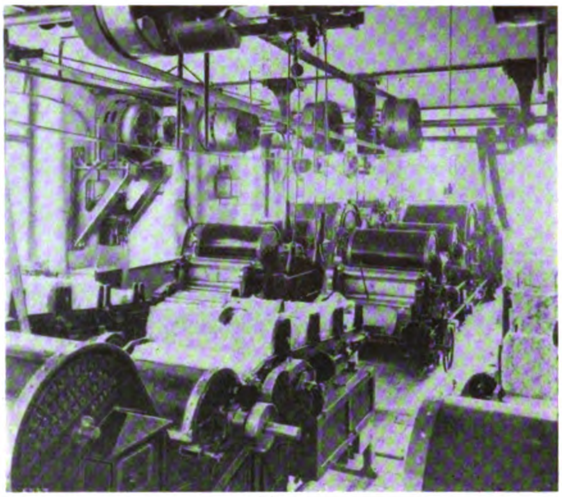


Fig. 2.
BLOWING-ROOM,
OPERATED BY 50-H P. INDUCTION MOTOR.

adopted in all textile mills, the problems met in the group system of driving were very early solved, and the methods originally adopted have proved themselves to be sound and satisfactory. Usually the machinery placed in the cotton room and mixing room is group driven from one line shaft, which is either belt or rope driven from a single motor, the speeds of these machines being unsuitable for a line shaft having the motor directly connected thereto.

In the blowing room, the machine speeds are such that the speeds of the line shaft and motor can be alike, and here it has been usual to connect the motor directly to the shaft, the limiting feature of the speed being the absence of vibration on the shaft, taking into consideration the weight of the shaft, the distance apart of the bearings, and the positions of the driving pulleys.

In both these departments of the mill, squirrel cage motors have usually been adopted because of their robust construction, and the fact that only a small torque is required for starting in these departments, the amount of shafting involved being small.

In the card room various methods have been tried, the different arrangements of the card rooms in different mills being such that what would suit one concern would not necessarily suit another. Motors have been

fitted driving the shafts directly at medium speeds, and driving by belt, rope, chain or gear at normal low speeds, all with good results. In almost all cases in this department, the motors

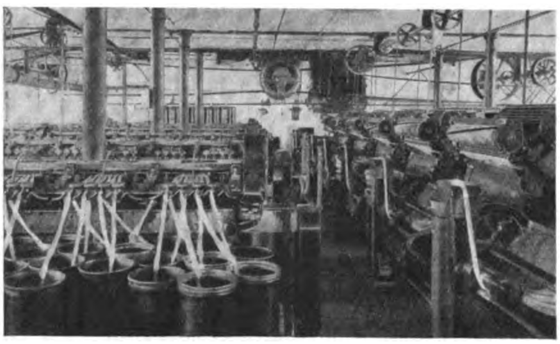


Fig. 3.
CARD-ROOM, OPERATED BY 130-H.P. INDUCTION MOTOR

are installed on foundations near the ceiling, and in some cases inverted against the ceiling, in order that valuable floor space may not be taken up. A recent method of driving the card shaft is to run the line shaft at a medium speed, and drive from a motor erected close alongside by means of a chain drive.

The preparation frames in the card room are usually driven by means of a motor directly connected to the line shaft, which can be run at a somewhat higher speed than that driving the cards, the frames being driven from the shaft by means of the usual half cross belts.

In the mule spinning rooms the method adopted originally was to group as many machines as possible, up to say twelve or fourteen pairs of mules, on one motor. The variation in power on each of these machines was known to be considerable, and it was anticipated that by grouping a number of machines on one motor the combined effect of such variations at the motor would be lessened. Experience, however, has shown that the relative variation of power at the motor is much the same whatever the number of mules driven from such motor. The result is that electrical engineers now drive any number of mules from one upwards, according to the exigencies of the particular mill involved. A case in point is a mill containing five spinning rooms with five pairs of mules in each room. The best arrangement for driving in this case was such that two motors per room were necessary, and thus each mule motor in this mill drives five mules only, *i.e.*, two and a half pairs. They have now been running some eight years with perfectly satisfactory results. In other cases two mules only are grouped on one motor.

The motors in these rooms are, wherever possible, connected directly to the line shafts, which are run at high speeds, and slip-ring type of motors are usually installed.

In the ring spinning and doubling rooms methods have been adopted similar to those for the mule spinning, the only difference being that in this case the load demand for the machines is extremely constant, presenting no special difficulties to the engineer. In these departments line shaft speeds as high as 960 r.p.m. have been utilized.

Winding, reeling, bundling, warping, slashing and sizing machines are usually driven by separate motors, belt or chain, connected to the various line shafts for each group of machines. These machines require only a very small amount of power.

The methods adopted for driving cotton mills as instanced above have also been used for driving other textile mills. Woollen mules are driven in much the same way as the cotton mules above, see Figure 9.

Figure 10 shows jute spinning frames group driven on the top floor of a three-storey mill, in the same manner as is usually adopted for cotton ring spinning.

Since this first mill was equipped, progress has been made generally on the lines of increased speeds and motor efficiencies, further

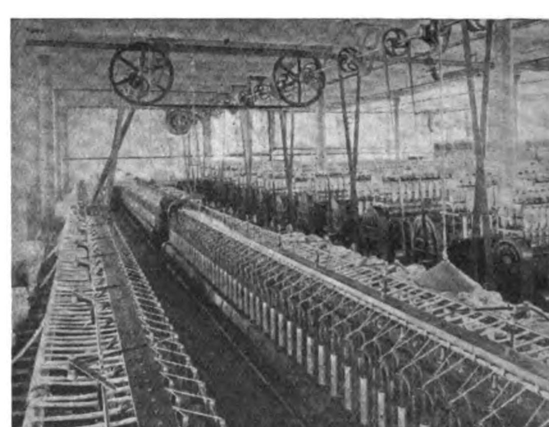


Fig. 4.
CARD-ROOM, OPERATED BY 90-B.H.P INDUCTION MOTOR.

sub-division of units, and more particularly in the application of separate motors to individual machines. There are to-day a considerable number of concerns and departments of mills

equipped throughout with one motor to each machine, this method having been exploited to a considerably greater extent in other countries than in the United Kingdom. The tendency for years has been towards a reduction in the average size of motor installed, and it would appear that our foreign friends are in this respect somewhat in advance of us, in that they have carried through a considerably greater amount of what is usually called "individual driving" than it has been found possible to do here. Italy, Germany and Switzerland were among the first to adopt the individual drive in this class of work, and America in the last four or five years has been extending rapidly in this direction.

In this development of textile mill driving, additional difficulties have been encountered which were not foreseen. In some of the earlier individual drives considerable trouble was experienced, and, whilst at the moment a large amount of progress in this direction has been made, it cannot be said that finality has been reached. New difficulties are continually cropping up and different methods of surmounting these being evolved. It would appear from present indications that the future development will be more general along these lines, and that more and more machines in mills will be driven each by its own motor, the very many commercial advantages of this system having been found to outweigh the disadvantages

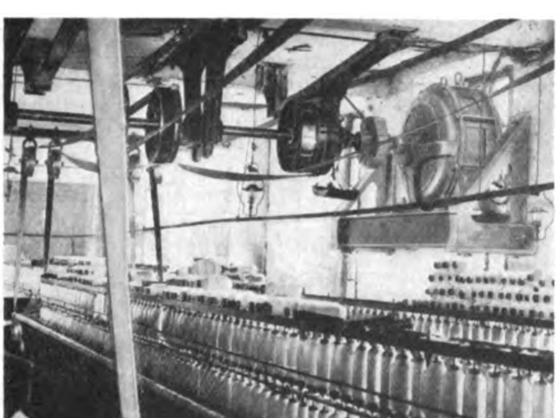


Fig. 5.
RING SPINNING FRAMES,
OPERATED BY 45-H.P. INDUCTION MOTOR.

involved in increased first cost and multiplicity of parts.

During recent years, individual machine driving has been applied more particularly in connection with the machines in the following departments of spinning mills:—

Blowing room,
Preparation frames,

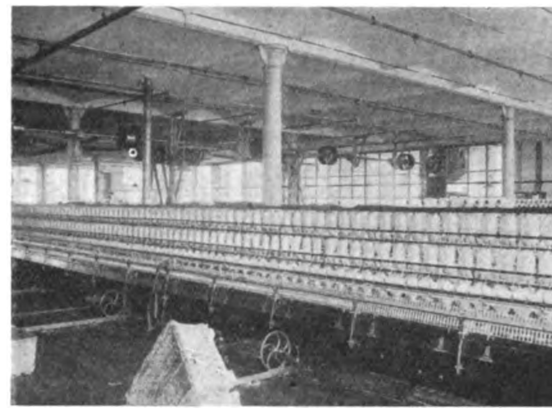


Fig. 6.
RING SPINNING FRAMES,
OPERATED BY 200-B.H.P. INDUCTION MOTOR.

Ring spinning room,
Doubling room,

and also somewhat extensively in the weaving shed. On spinning and doubling frames, particularly, the individual drive appears to possess considerable advantages.

On spinning frames, Mr. George P. Gilmore, in a paper read before the Master Mechanics' Association of America at Fall River on the 19th of May, 1911, gave figures of production, comparing similar machines on similar counts, driven (a) by individual motor, (b) by ordinary mechanical means, the spindle speed in the case of the individually driven frames being constant for each size of rings in counts varying from 10's to 70's. The following are the figures:—

Counts of Yarn.	Twist per inch.	Lb. per spindle. Motor drive.	Lb. per spindle. Belt drive.	Percentage increase with motor drive.
10's	11·0	7·46	3·5	113·2
24's	17·2	1·89	1·61	17·3
30's	19·2	1·53	1·36	12·5
36's	21·0	1·15	1·01	13·9
40's	22·2	1·045	0·87	20·0
45's	23·5	0·85	0·76	11·8
46's	23·7	0·835	0·74	12·8
50's	24·7	0·72	0·61	18·0
70's	25·14	0·465	0·33	41·0

These records were obtained after the plant had been in operation two-and-a-half years, and show an average increase on the nine

different counts of yarn given of 28·9% as obtained in this particular mill. It should be pointed out, however, that "the great increase shown in the production of 10's was largely due

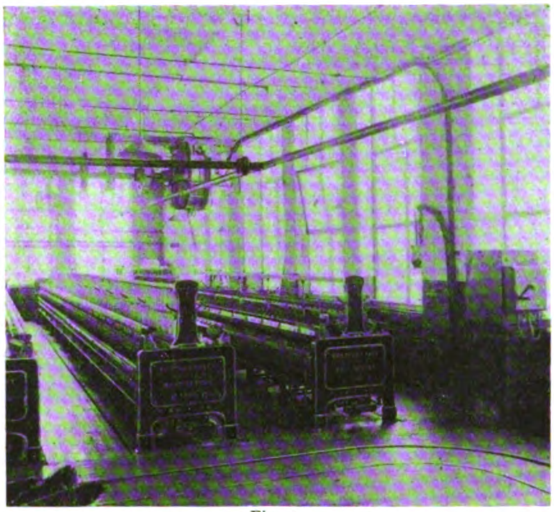


Fig. 7.
RING SPINNING AND DOUBLE FRAMES, OPERATED BY 150-B.H.P. INDUCTION MOTOR.

to the fact that the mechanically driven frames were not properly equipped or fitted to spin this count." The average increase on the other eight cases works out at 18·4%. No figures are available to show what would be the difference in production between frames driven in this manner and frames electrically driven from a group driving motor, such as illustrated in Figures 7 and 8.

The foregoing figures compare very favourably with the estimates which were put forward by the advocates of this drive.

Some years ago a special type of induction motor for spinning frames was placed on the market in the United Kingdom, the motor having the usual induction motor characteristics, and in addition (by means of a commutator rotor) being provided with speed changes by automatically moving the brushes. The object of this was to give a varying speed on ring spinning frames in an attempt to provide equal tension on the yarn between the limits of winding on the bare bobbin and on the outside of the cops. A few examples of this type of motor are still in operation, but the general opinion among textile manufacturers appears to be that the benefit derived does not render this a commercial success. Comparative tests on such motors, and on constant speed motors, both directly coupled to the frame shaft, have shown results favourable to the latter.

In the paper already referred to, Mr. George P. Gilmore states :—

"Some attention is now being given to variable speed motors to be direct connected to the cylinder shafts. In view of the results obtained from one large installation with motors directly coupled to the cylinder shafts, I am of opinion it is not necessary to change the cylinder speed with this drive as often as has been the practice with belted drives."

The majority of modern installations of individual drive to ring spinning frames and ring doubling frames have constant speed motors directly coupled to the tin drum shafts, and as a result of the large amount of experience gained in such applications, the tendency appears to be to develop further along these lines.

In blowing rooms, individual driving is coming rapidly into vogue in the United States, and special motors suitable for this class of work have been developed. The speeds of the beaters on these machines are often such that it is not possible to couple induction motors to them directly, and it is usual in these cases to drive the machine by belt, the motors being placed either on a special framework on the machine, or on the ceiling in the blowing room. There are many features in favour of this application, among them being the elimination of all the usual overhead counter shafts, belts and pulleys,

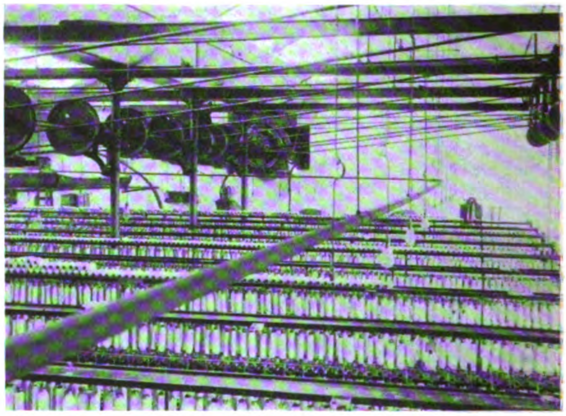


Fig. 8.
RING SPINNING FRAME, OPERATED BY 250-H.P. INDUCTION MOTOR WITH ROPE DRIVE TO FRAMES.

and the fact that in case of fire on any one machine (which often happens in blowing rooms) the cotton in that machine can be run out and the fire extinguished without interfering with

the other machines. The motors for this class of work are usually specially treated, in order that they may withstand the effects of water used in extinguishing such fires.

The preparation frames in the card rooms are also favoured for individual driving, the reasons here bearing on the intermittent nature of the running of these machines during normal working. In these cases it is usual to have the motor placed at the frame end and gear down to the driving shaft of machine.

In almost all cases of individual driving in the machines under notice, squirrel cage type motors are used, and the starting switches for them are usually connected up to the frame in such a manner that the attendant operates the motor much as she would the ordinary belt shifting gear. This is particularly the case in regard to the preparation frames, the ordinary operating levers on these frames being connected to the starting switch, enabling the attendant to start or stop the motor from any position along the frame.

There are many other machines connected with textile manufacture which lend themselves particularly well to driving individually Especially is this the case in the finishing and printing departments, and for inspection and cloth looking in the warehouse, and for these departments individual drive per machine is becoming much more general.

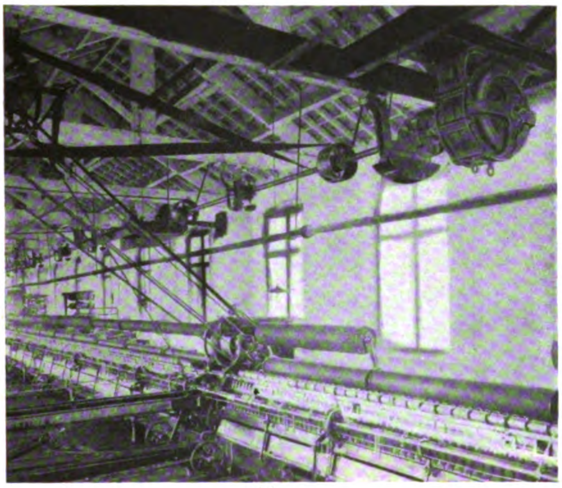


Fig. 9.
WOOLLEN MULES, OPERATED BY 25-H.P. INDUCTION MOTOR.

A further field for individual driving which has been somewhat extensively exploited is the application of a single motor to looms in weaving sheds. Special small totally enclosed motors have been devised of high efficiency and low temperature rise, fitted with spring belt tightening suitable for placing on the floor alongside the loom and driving the loom by

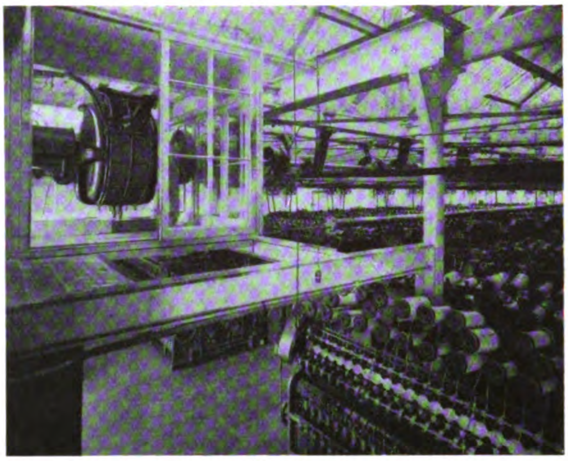


Fig. 10.
JUTE SPINNING AND COP WINDING MACHINES, DRIVEN BY 210-H.P. INDUCTION MOTOR.

belt in the usual manner. This type of motor has been applied to looms throughout the textile industry, not only for cotton, but also for woollen, jute, flax and silk. It has also been applied to looms which have a very low load factor, and to such looms as Northrop looms, which are running practically continuously.

The elimination of all overhead shafting and belting, the improvement effected in the lighting of the rooms, and the extreme cleanliness of such drives have proved of great satisfaction to manufacturers.

Probably as great a success has been attained in this application of individual driving as in any other.

Many looms are also individually driven through the medium of spur reduction gearing, the motor being provided with a suitable fibrous pinion gearing into a cut wheel, the latter being mounted on the loom crank shaft and driving through the medium of a slipping clutch. This being necessary in order to prevent breakage of loom parts in case of a false pick.

The great advantage appears to be in the constant speed at which the loom is driven, and also the saving effected in power consumption by stopping the motor with the loom.

In this case also the starting switch for the loom motor is invariably coupled to the ordinary strap fork mechanism, as used in belt driven looms. The operative therefore starts and

stops the loom in the manner to which he has grown accustomed.

This development appears to be gaining favour throughout the world, although in

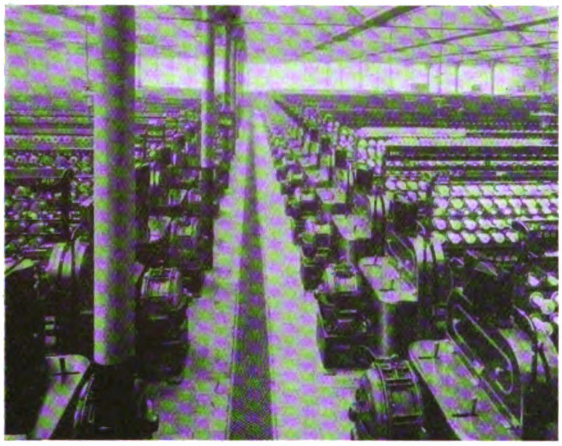


Fig. 11.
RING DOUBLE FRAMES
OPERATED BY INDUCTION MOTORS.

different countries different types of motors are used for this work. The general practice in the United Kingdom appears to be always to have highly efficient motors, the rotor running in ball bearings and being totally enclosed.

For old mills in which the shafting already exists and is in good condition, the group drive is still, however, more generally adopted; in fact, one of the latest new mills to be erected in Lancashire is equipped throughout on the group system, the motors being directly connected to the line shafts in all cases except for the two card shafts, which are chain driven from the motor shaft.

As previously stated, the fact of the great development which has taken place in electrical transmission for textile mills during the last ten to twelve years, and the extensions which are continually being carried out on the same lines, not only in new concerns, but also in those which have had extended experience of the advantages of this method, shows that the claims advanced originally by the advocates of this system have proved themselves to be commercially sound in practice, and further developments on similar lines are evidently to be expected in the future.

It is a significant feature of this development that probably 50% of the installations which have been carried through are taking their power from public Supply Companies or Corporations. Textile manufacturers are very keen to take advantage of the opportunities provided by such Supply Companies, to enable them to have a supply of power and relieve them of the necessity for making their own. Throughout the country generally there now exist supply stations, governed by progressive engineers who are fully alive to the importance of providing power at reasonable rates to meet the demand of textile manufacturers. Manufacturers further appear to appreciate from many points of view the advantages they derive from obtaining their power in this manner. They are enabled to devote the whole of their energies to seeing that their machinery is kept up to the maximum efficiency possible, and to devote a greater proportion of their total capital outlay to the installation of dividend producing machinery. Further, in case of extensions, they need consider at any particular moment merely the power required for their immediate needs. They need not look ahead in order to provide themselves with means for driving future possible or probable extensions. These can be left to take care of themselves. Power Companies are usually in a position to provide any reasonable extension to an existing plant with the necessary driving power at a very short notice.

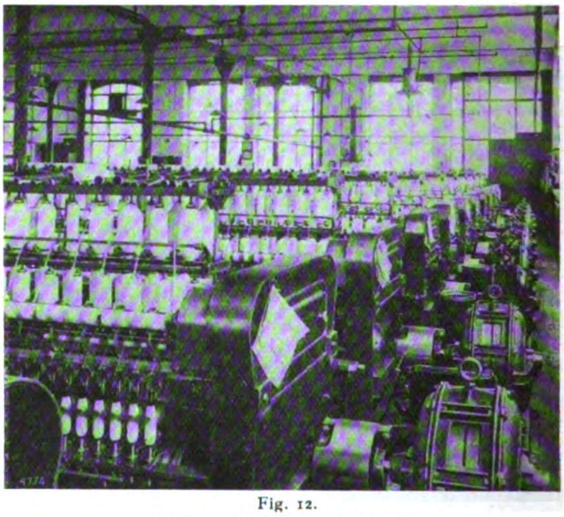


Fig. 12.
RING SPINNING FRAMES
OPERATED BY INDUCTION MOTORS.

Further, all Power Supply Companies are provided with duplicate or spare plant, thus ensuring constant supply without interruption or stoppage.

In Lancashire and Yorkshire particularly, Supply Companies appear to be reaping a very large harvest in this direction, to the benefit of both themselves and the textile manufacturers, and future development will apparently continue on these lines. Roughly the proportion between the installation of private plants in these counties and the installation of plants taking supply from Power Companies, is about 2 : 5.

The generating plant usually installed in power stations is particularly suitable for meeting the requirements of textile manufacturers. It has long been an axiom in this industry that if each and every textile machine could be driven constantly at a steady speed the maximum possible production could be obtained from such machine. Almost all electric power plants used for driving such concerns are, therefore, of the turbo-alternator type, the even turning moment of which is particularly suitable for the requirements of textile machines. Fuel economy also on these plants is as good as, if not better than, that of any other prime mover now existing.

Dealing with those cases in which manufacturers have been obliged to install their own generating plant, as mentioned previously in this article, mistakes were made originally, which, however, have only proved stepping stones to success later.

The amount of power required for driving any given mill is fairly constant throughout its period of working. There are times, however, dependent on outside influences, when the normal amount is enhanced and power plants

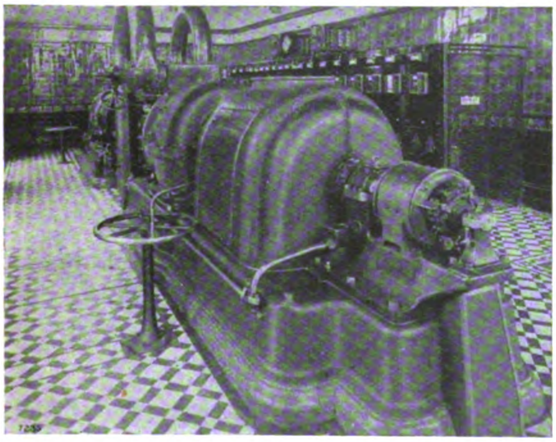


Fig. 13.

GENERAL VIEW OF POWER HOUSE, SHOWING TURBO-ALTERNATORS AND MAIN SWITCHBOARD.

require to be of sufficient capacity to provide for this. Many modern installations of private plants have been provided with duplicate generator units, each of which is large enough to provide for the full load on the mill, and manufacturers run these alternately week by week. In other instances no duplicate plant at all is provided and the results obtained appear to justify the confidence displayed in the reliability of such units.

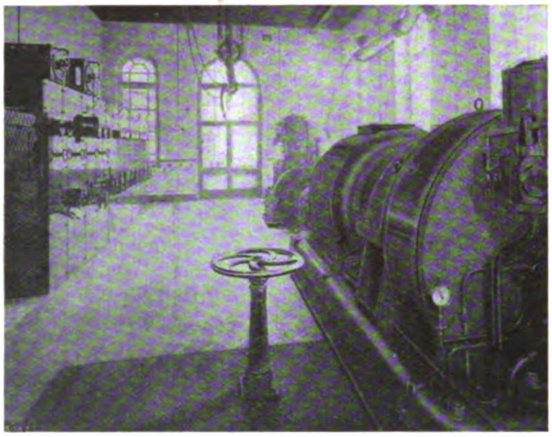


Fig. 14.

GENERAL VIEW OF POWER HOUSE, SHOWING TURBO-ALTERNATORS AND MAIN SWITCHBOARD.

Several concerns known to the writer have been running (one for over eight years) with a single generating unit only, with excellent results, both as regards economy of running and continuity of working.

Turbo-alternators, such as are used in mills, have proved themselves to be just as reliable as the plant which has been used for years for driving such concerns, and it would appear that, wherever it is necessary for private plant to be installed, manufacturers will continue to put down these units for generating their power.

Figure 13 shows two 1,500 K.W. Turbo-Alternators installed in an engine house originally containing one 750 I.H.P. engine. This plant is installed in Lancashire, and each of the two sets shown is capable of providing the whole power required for the complete mill, four engines having been displaced.

Figure 14 is an illustration of a 750 K.W. Turbo-Alternator which has been driving a flax spinning mill in Ireland for a considerable number of years. In this case the driving of the mill is dependent on a single unit.

It will be seen therefore that the progress of electrical driving in textile mills in the United Kingdom has been remarkable. In view of the wide experience gained by electrical engineers in applications over a very wide field, together with the advantages accruing to textile manufacturers in improvement of both quantity and quality of material, it is to be anticipated that the future progress of this method of transmission will be even more marked.

MANUFACTURERS' SECTION

BERRY, SKINNER & CO.

"FIRIMINE" SWITCHBOARDS FOR MINES

The problems arising out of the distribution of electric power in mines are many and varied. "Safety first" is now the motto of switchgear designers, and it must needs be applied not only to the mine as a whole, but also to the lives of individual workmen. Under the first heading comes the question of absolutely preventing explosions by sparking at switch and fuse contacts. The "Firimine" Iron-clad Switch was introduced some years ago, and has already proved its merits under severe service conditions. It is a combined switch and fuse made for one, two or three-phase circuits, with absolute interlocking action, whereby the circuit can only be made and broken with the iron cover of the device closed. Reinforced mica insulation only is used, and the entire construction is a sound engineering job. The switch cover is provided with wide flanges which are machined, and make a faced joint with similar flanges on the box itself. The effect of these flanges is immediately to cool any hot gases which may be fired in the interior of the switch: such gases pass harmlessly and without flame to the outside of the switch.

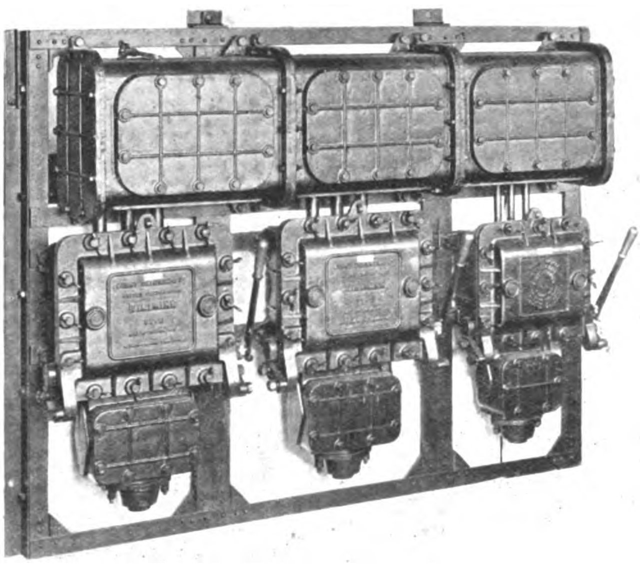


Fig. 1. MINING SWITCHBOARD WITH "FIRIMINE" SWITCHES.

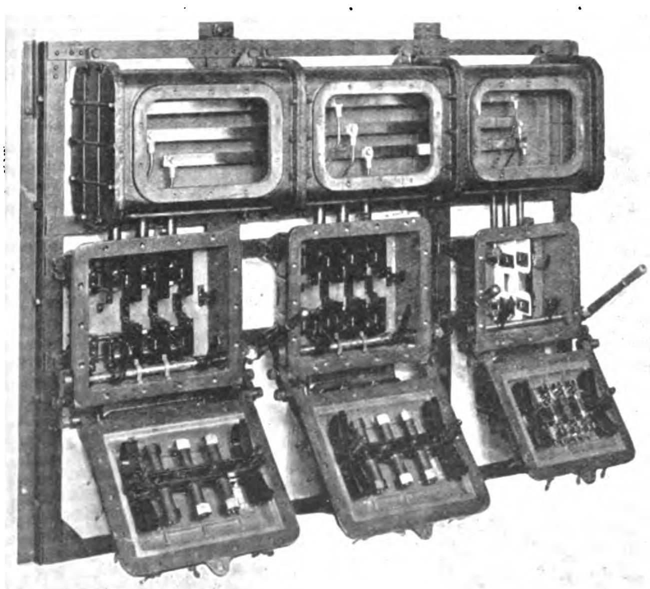


Fig. 2. ANOTHER VIEW SHOWING SWITCHES AND 'BUS-BAR CHAMBER OPEN.

The illustrations serve to show how neatly these switches can be built up on an angle-iron frame to form, with 'bus-bar chambers and connecting boxes, complete boards for use in the underground working of mines and collieries, especially where firedamp is known to be prevalent. It will be noted that both the switches and the 'bus-bar chambers are rendered completely accessible, and that the boards are built up on the unit principle.

BRITISH THOMSON-HOUSTON CO., LTD.

ELECTRICAL MACHINERY FOR ROLLING MILLS AND STEEL WORKS

The British Thomson-Houston Co., Ltd., of Rugby, England, have devoted special attention to the electrical equipment of rolling mills and steel works. They have supplied and installed a large number of heavy motors with special control gear and other apparatus designed for the heavy and continuous duty incidental to rolling mill service.

The British Thomson-Houston Co., Ltd., quickly recognised the substantial economies effected by the electrically-driven rolling mill, and the centralization of the power-generating plant made possible by its adoption. With the great resources and manufacturing facilities at their disposal they are able to supply complete electrical equipments for steel works and rolling mills of the largest size.

The extremely heavy and onerous duties of electrical apparatus in rolling mills can only be performed by machinery designed for that special purpose, and embodying material and workmanship of the highest quality. Its manufacture can only be successfully conducted in works replete with the proper and most modern equipment for the purpose; the plant of the British Thomson-Houston Co., Ltd., is of this description. The mechanical and electrical features of motors and control gear for

rolling mills and steel works have been the subjects of their particular care and study, and they are the owners of many patents covering details and devices indispensable for the continuous, successful and economical operation of this class of machinery.

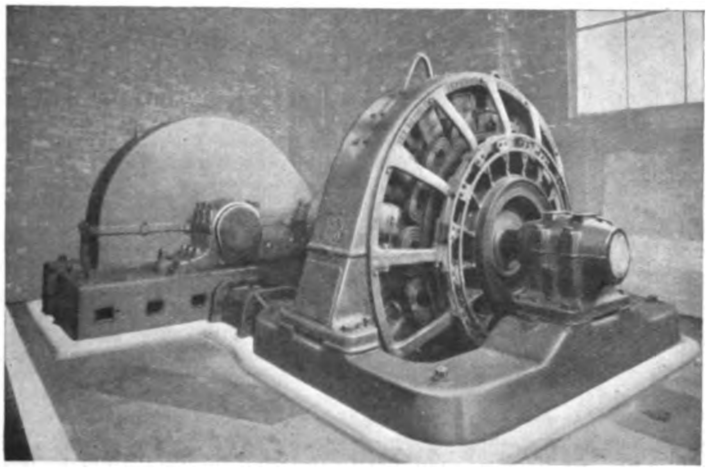


Fig. 3.
600/1800 H.P. 117/165 R.P.M. D.C. MOTOR AND GEAR FOR 24" COGGING MILL.

One of the most interesting and difficult problems in rolling mill work is presented by the electrical driving of the large two high reversing mill, and the British Thomson-Houston Co., Ltd., have installed several equipments of this class.

The essential features of such an equipment are :—

(1) Equalization of the demand for power.
(2) Rapidity and ease of operation.
(3) Reliability.

The first requirement can be satisfied in the usual way by the employment of a motor generator set with a very heavy flywheel. The speed and direction of rotation of the mill motor is controlled by regulating the field current of the generator, which must be capable of carrying very heavy currents without excessive heating or sparking at the commutator. These conditions can only be satisfied by the use of properly designed compensating windings and commutating poles so proportioned that the use of inductive shunts is unnecessary. The British Thomson-Houston Co., Ltd., have designed and patented a commutating pole construction to meet these requirements by means of which the generator can be adjusted to give practically perfect commutation at all loads and all conditions of excitation.

The second requirement can be fulfilled by the use of the special systems of compounding, designed to limit the momentary current rushes due to rapid reversal and acceleration of the mill motor and protected by the patents of the British Thomson-Houston Co., Ltd.

Reliability can only be ensured by special attention to mechanical and electrical features, combined with the use of suitable materials and the best manufacturing processes. This applies with special force to the insulation of the electrical parts, a matter which has received the particular attention of this firm. British Thomson-Houston continuous current generators and motors for rolling mill service are built with mica insulation moulded and pressed on the armature bars, and special precautions are taken to avoid the lodgement of dust and dirt at the backs of the commutators. The commutators are assembled with the greatest care and most thoroughly seasoned so that tightening and grinding on site are unnecessary. Insulated windings for field spools are repeatedly vacuum dried and impregnated, and the whole of the material used is submitted to the most searching inspection and tests.

High tension alternating current motors for driving three high and non-reversing mills are built with solid impregnated coils insulated with machine moulded hot pressed mica, and laid in open slots. This type of insulation is highly resistant to the effects of the dust prevalent in rolling mills, and the construction is such that any coil may be reproved and replaced with the minimum expenditure of time and trouble. The rotor windings are of heavy copper bars insulated with mica, and the sliprings and brush gear are of the most substantial construction.

The mechanical features of rolling mill motors built by the British Thomson-Houston Co., Ltd., include very stout shafts, self-oiling bearings carried in short stiff pedestals, and heavy baseplates with foundation bolts distributed in the most advantageous manner to secure rigidity and freedom from vibration. Machines for use in very dusty or dirty situations are totally enclosed and provided with suitable air filters.

The control gear for these large motors is of the contactor type, and in many respects similar to that so successfully developed by the British Thomson-Houston Co., Ltd., for electric railway service. The distinguishing feature of the contactor starting and regulating gear manufactured by this Company is the system of current limit control incorporated in it. By means of it the operation of the various contactors is made to depend on the value of the current and not on the time of operation of a dashpot or the counter electro-motive force of the motor. With this system of control it is possible to adjust a set of contactor starting or regulating gear for a definite maximum current, which remains invariable and unaffected by changes in the operating conditions of the mill; the motor is thus protected against carelessness on the part of the attendant, who is relieved of all responsibility after he has closed a small starting switch. Further, the motor may be started or stopped by push buttons or small snap switches from any convenient situation about the mill.

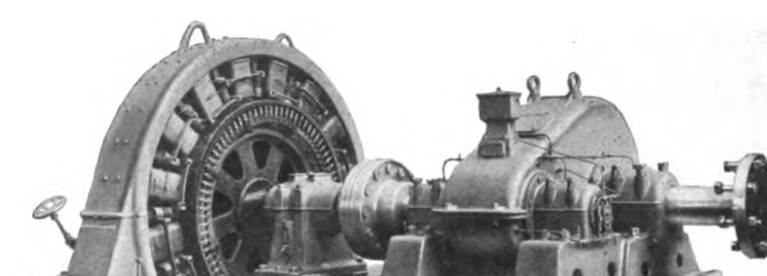


Fig. 4.
1000/2000 H.P. 175/350 R.P.M. D.C. MOTOR AND REDUCTION GEAR FOR TYRE MILL.

The heaviest duty in a rolling mill is performed by the motor which drives the live rollers, lifting tables,

screw-downs and similar devices. They have to be started, stopped and reversed with extreme rapidity and frequency, and when ordinary hand-operated control gear is used are often called upon to carry

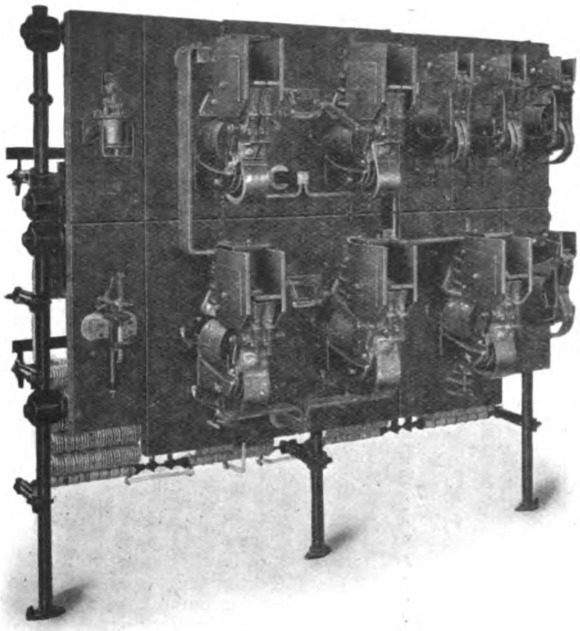


Fig. 5.
AUTOMATIC STARTING AND REVERSING GEAR FOR 1000 H.P. D.C. MOTOR FOR TYRE MILL.

excessively heavy rushes of current which, sooner or later, result in injury to the armatures, or breakage of shafts or pinions, and annoying and costly delays, all of which can be avoided by the use of contactor control gear with current-limiting attachments.

The British Thomson-Houston Co., Ltd., have developed suitable contactor control gear for this onerous duty, and Fig. 6 shows a set designed for an alternating current motor. It will be noted that the controller, which is shown under the control panel, and deals only with the small currents for the operating coils of the contactors, is very small and can be worked continuously without fatigue of and consequent diminution in the efficiency of the attendant. It has an " off " position and one slow running and one full speed point for each direction of motion, and does not require any skilled or careful handling, for the action of the current limiting devices is such that it can be thrown right over from one full speed position to the other without causing any excessive current rush and without any possibility of injury to the motor or driving gear. In spite of its slightly greater first cost, this contactor control gear is rapidly replacing the cumbersome and inefficient hand-operated controllers hitherto used, and steelworks' managers recognise the fact that the additional expenditure is quickly recouped by the freedom it ensures from expensive and annoying stoppages.

In conjunction with these special control gears, the British Thomson-Houston Co., Ltd., have placed on the market a line of alternating and continuous current mill type motors especially designed for driving live rollers, screw-downs, etc., and for installation in hot and dusty situations. The mechanical and electrical parts of these motors are of the most liberal proportions, and the insulation, which is of mica and asbestos, is practically fire-proof. For this class of service the ordinary traction motor possesses great advantages, and has been very widely used. In the construction and design of the new type mill motor all these advantages have been retained and accentuated to the greatest degree, with the result that it is replacing the older type just as rapidly as the contactor control gear described above is superseding the older hand-operated tramway type controller.

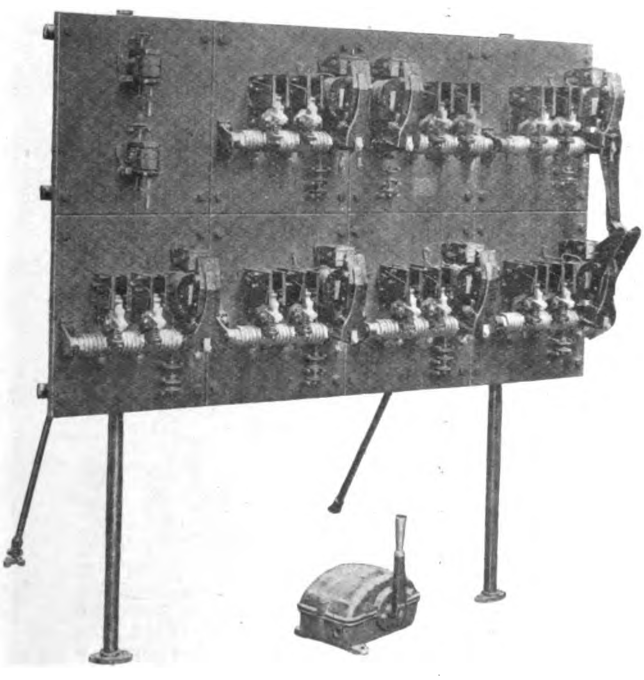


Fig. 6.
AUTOMATIC CONTROL GEAR AND REVERSING CONTROLLER FOR A.C. MOTOR FOR LIVE ROLLER TRAIN.

BRUCE PEEBLES & CO. LTD.

Fig. 7 shows the interior of the Air Compressor House of a large Dock Company " somewhere in England," the plant appearing in the illustration being three 160 B.H.P. 333 r.p.m. Peebles Open Type Slip-Ring Induction Motors, each fitted with two pedestal bearings and Peebles Patent Interlocked Slip-Ring Short-circuiting and Brush-lifting Gear; the stators are wound for a 3-phase, 40-cycle, 2,750 volt circuit. Each of these motors is directly coupled through a flywheel to and mounted on a combination cast-iron bedplate with a Belliss Air Compressor.

The motors are started by means of liquid starters placed near them, while the switchpanels, which are of the usual compact ironclad pattern, are to be seen at the extreme end of the room.

Each motor is fitted with both stator and rotor cable trifurcating boxes, the pipes for conveying the leads from the slip rings to the starters being clearly shown in the illustration.

Fig. 8 shows the main and subsidiary electrically driven pumps of a large Shipbuilding and Dry Dock Company situated also " somewhere in England." The two main pumps which are used for unwatering the docks are each capable of pumping 24,000 tons of water in two hours, and are each driven by a Peebles 260 B.H.P. 335 r.p.m. End-Hood-Pedestal Slip-Ring Induction Motor fitted with Peebles Patent Interlocked Slip-Ring Shortcircuiting and Brush-lifting Gear, the circuit being 3-phase, 40-cycles, 440 volts.

As in the case of the machines in Fig. 7, these motors are each provided with stator and rotor cable trifurcating boxes, and are started by liquid starters,

one of which appears in the foreground of the illustration. Previously the docks in question were unwatered by a steam pumping plant, which has now been superseded by this new electrical installation.

The small induction motor in the background is also a Peebles machine; it is of 37½ B.H.P. at 773 r.p.m.

The larger motors, are of a particularly useful design. The bearings, of the pedestal type, are carried by very substantial end hoods; by this arrangement no bedplate is necessary, and a very compact motor is the result. These machines are well adapted for directly coupling to pumps, fans or similar apparatus.

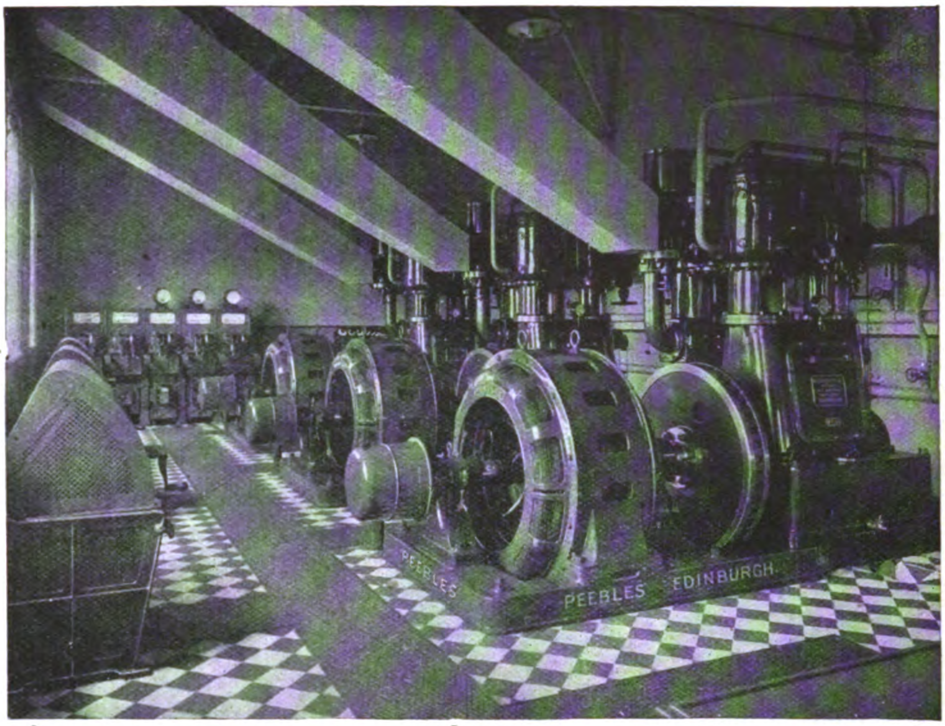


Fig. 7.

The Peebles Interlocked Shortcircuiting and Brush-lifting Gear, which is fitted to each of the six motors described in the foregoing, is the finest device of its kind on the market. The whole operation of short-circuiting the slip-rings and raising the brushes is carried out in the correct order by the continuous movement of a lever handle.

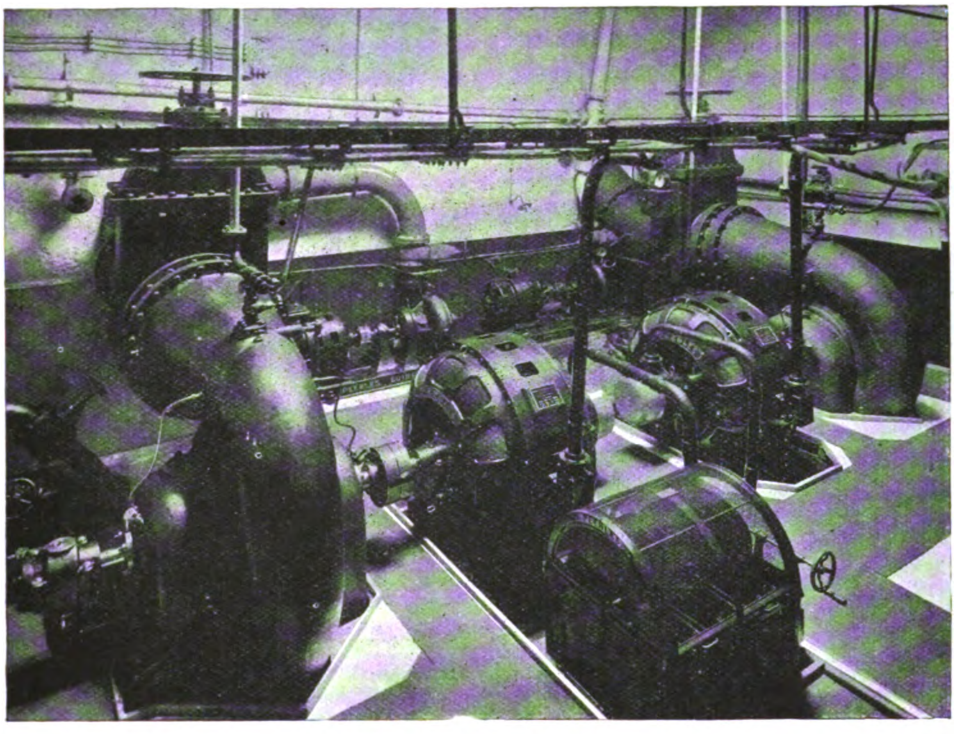


Fig. 8.

CROMPTON & CO., LTD.

MACHINE TOOL DRIVING

The above firm, of London and Chelmsford, has given special attention during recent years to the advancement of alternating and continuous current motors of all types and to the general design, construction, and erection of electric power plant of every description from the small portable machine tools to large rolling mills and main winders.

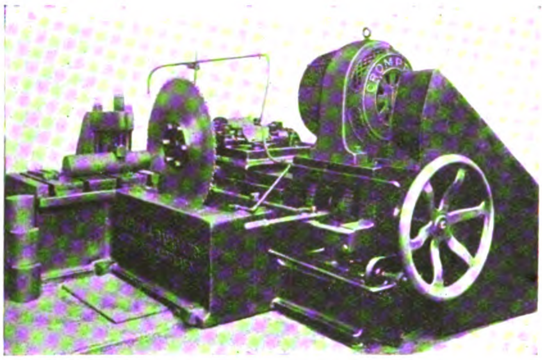


Fig. 9.
MOTOR DRIVING CIRCULAR METAL SAW.

There is at the present time an abnormal demand for for electric motors required for driving all classes] of industrial machinery and tools, due to high efficiency, adaptability and flexibility of the electric drive, the advantages of which are unapproachable by any other method of driving.

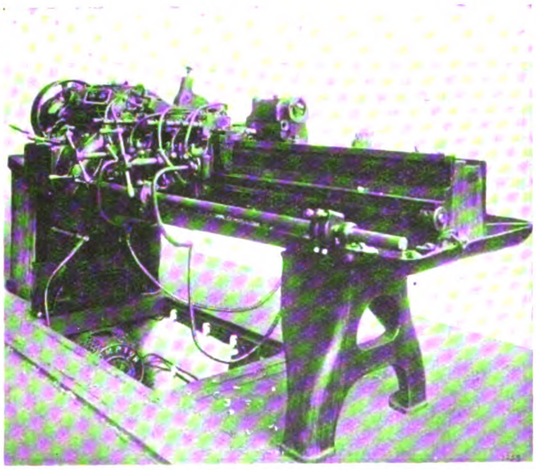


Fig. 10.
LATHE WITH PUSH-BUTTON CONTROL.

The principal demand for motors is in connection with plants where electricity has not been previously employed for power purposes, and where it is essential for the maximum output to be obtained from the tools with a minimum power consumption.

The facility of carrying out extensions and adapting the existing tools to electric drive, are points of considerable importance in which electricity is incomparably superior to any other system.

A Crompton protected type continuous current motor adapted to driving a circular metal saw through chain gearing, is shown in Fig. 9 ; the simplicity of the drive and small space occupied are features which are particularly noticeable.

An electrically-driven lathe, operated automatically by push-button control, is shown in Fig. 10, and is an example of many other similar lathes equipped with Crompton continuous current motors. The motor and switchgear are fixed in a pit under the lathe, the motor driving upwards by means of a short belt. The automatic solenoid starter is controlled by two push-buttons, one for starting and the other for stopping ; they are fitted in a convenient position on the lathe head stock, within easy reach of the operator. The leads from the switchgear to the push-buttons are encased in water-

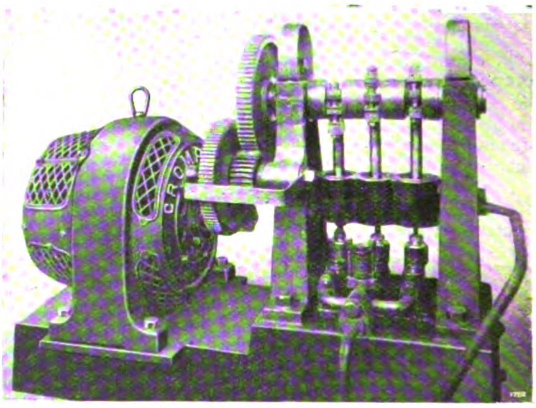


Fig. 11.
MOTOR-DRIVEN HYDRAULIC PUMP.

tight flexible metal tubing. When desired a field regulator is provided to vary the speed of the motor beyond the limits obtainable with the change gears of the lathe. The workmen prefer this method of control to the ordinary type of starter owing to the facilfty oi operation. The arrangement could be extended, by providing switchgear so that the speed regulation is also obtained automatically by push-button control on the "Crompton-Kohler" system.

In many modern engineering works, including munition shops, the use of hydraulic power is often of very great convenience, and many self-contained hydraulic pumps driven by Crompton motors have been installed. A view of one of these small sets is shown in Fig. 11.

It is quite an easy matter to arrange for such a plant to be portable, which would still further increase the advantage of electric driving.

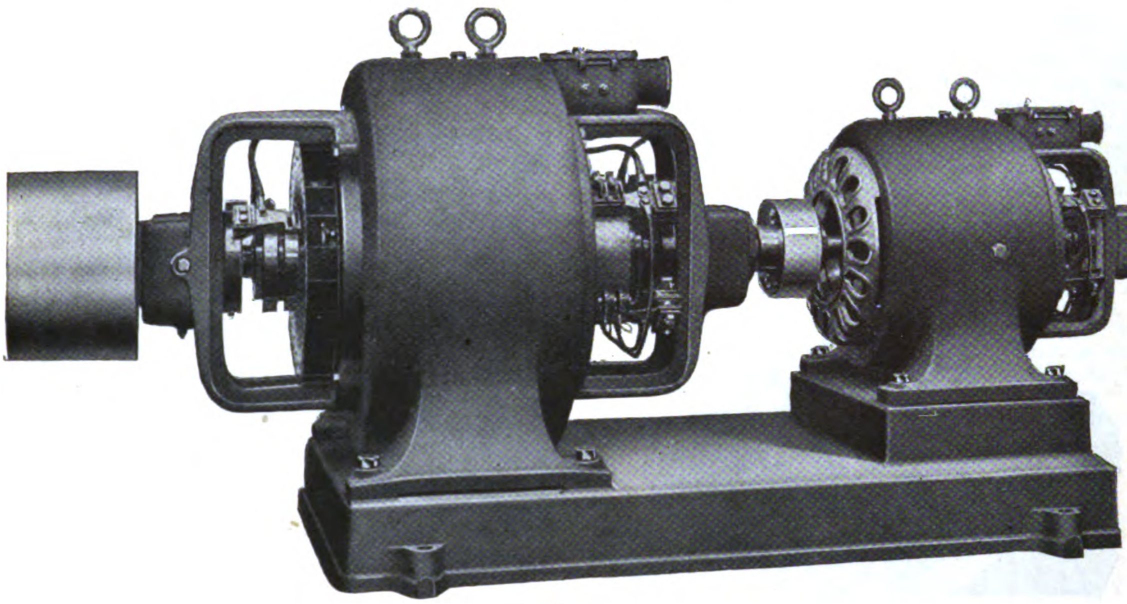


Fig. 12.

ELECTROMOTORS, LTD.

Fig. 12 is an illustration of a generating set suitable for a small country town.

The main generator is of the compound wound open protected type designed for belt driving, and fitted with interpoles. This particular illustration shows a 40 K.W. set giving 460 to 500 volts at 900 to 1,000 r.p.m.

At the opposite end to the commutator slip rings are provided for use in conjunction with the static balancer, giving a three-wire supply with 460 volts across the outers, and capable of dealing with 20 per cent. of normal full current in the neutral.

Directly coupled to an extension of the shaft at the dynamo end is an open protected type interpole boosting dynamo with one bearing, capable of an output of 80 to 250 volts, 45 amps., at the above-mentioned speed, suitable for raising the main generator voltage for charging the accumulators from which the supply is taken in the night time when the dynamo is shut down.

Both machines are coupled on substantial cast-iron bedplate, and provided with slide rails for belt tightening.

Th earrangement forms an ideally simple and inexpensive solution of the problem of Urban District Supply and can, of course, be modified in size to meet individual requirements.

THE GENERAL ELECTRIC CO., LIMITED.

THE OVERSEAS TRADE

Various suggestions have been made for a constructive policy to enable British manufacturers to take the fullest advantage of the overseas trade, which is confidently expected to develop after the war. Many of the proposals involve a drastic re-organization of pre-war methods as followed by the general run of British industrial concerns. They demand not only co-ordination in manufacture, but a wide extension of the means taken to secure business and carry out orders in the world's markets.

With this subject as focus of discussion, it is interesting to realize that the organization put into action by The General Electric Co., Ltd., before the war is precisely of the character towards which war-awakened enterprise in other countries is now tending. The war will not bring about any material change in this organization. All that will be necessary is that the machinery already at work should " carry on " upon the broader basis which trade growth after the war will demand.

The dominating feature in electrical overseas trade is the activity of large electrical manufacturing companies which canvas actively for business in even the remotest corners. The pace is set, so to speak, by the American and German electrical combinations, which have enjoyed protected home markets and other advantages not yet granted to British firms. Competition under such conditions has not been an easy matter, but it has not been found impossible. Recognizing that it was essential to conduct operations on a scale comparable with that of the chief rivals abroad, the G.E.C. set itself many years ago to build up overseas

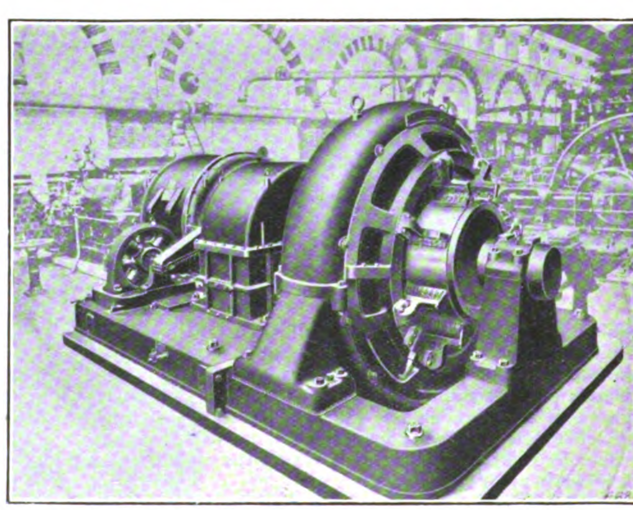


Fig. 13.

companies capable of supplying the electrical demands of all the chief markets. These companies, through their connection with the co-ordinated manufacturing concerns of the G.E.C. in Great Britain, were able to quote for complete electrical installations. They were, moreover, provided with staffs capable of erecting the installations and putting them into operation. This organization has reached so high a stage of development that the overseas companies have not only laid down complete power plants, but have actually placed stock orders for electric supply equipments, including power

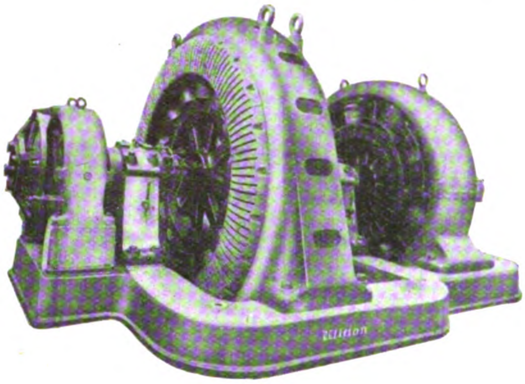


Fig. 14.

houses, switchboards, transformers, distribution cables, lamps, motors and all accessories. In a word, manufacturing and business-getting facilities have been correlated in a steady and vigorous growth.

While the world-wide selling organization directly benefits the general electrical engineering, the cable, telephone, instrument, carbon, lamp and other factories of the parent Company, it also brings a great deal of grist to British manufacturers allied with the electrical industry. Orders for turbines and other steam-driven engines, for gas, oil and other internal combustion

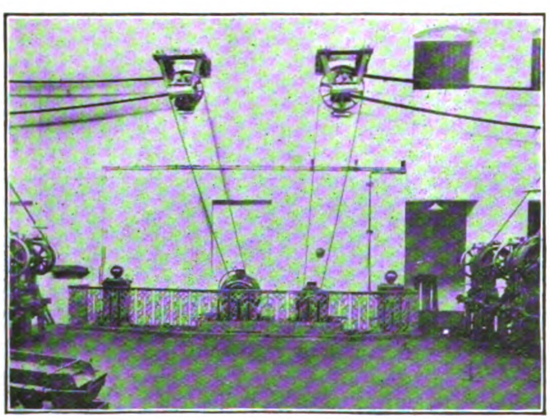


Fig. 15.

engines, for producer-gas installations, for boilers, condensers, pumps, economisers and numerous other accessories are involved in contracts for complete electric power equipments. Thus the G.E.C. organization acts as a feeder for the manufacturers of other non-electrical items, and has been the means of bringing orders to British firms from parts of the world where they were not represented.

It may be of interest briefly to give some idea of the G.E.C. overseas organization and of the kind of plant it supplies.

SOUTH AFRICA is covered by the British General Electric Co., Ltd., whose headquarters are at Johannesburg, with branches at Cape Town, Durban, Bulawayo and other places.

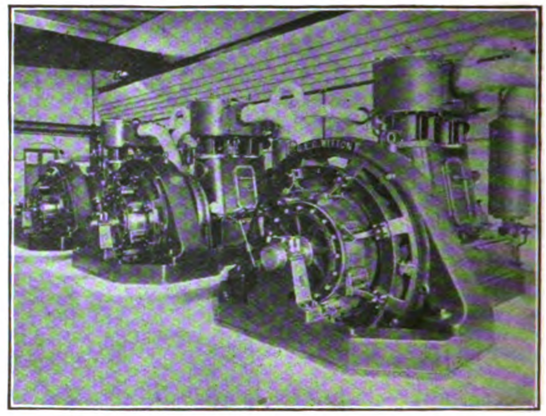


Fig. 16.

The 1,000 kw. "Witton" generator shown in Fig. 13 is located at the Power House of the Durban Corporation and is driven through gearing by a Parsons Turbine. This is a typical example of plant sent abroad by the G.E.C. One of the special lines of activity of the South African Company consists of complete town lighting schemes—Ermelo, Pietersberg and Bethel provide a few examples out of many. Undertaking to supply the whole of a power plant and distribution system, the South African Company is able to deal with schemes in a manner far more satisfactory than if plant and apparatus were ordered piecemeal.

Much other important work in South Africa has been undertaken by this Company, including, for instance, a pumping plant for the Rand Water Board.

AUSTRALIA.—The British General Electric Co., Ltd. of Australia, is actively engaged in the electrical trade of the Commonwealth. Its headquarters are in Sydney; its branches are at Brisbane, Melbourne, Wellington (N.Z.) and other places. As a typical instance of "Witton" plant supplied to Australia, it may be mentioned that two 275 k.v.a. alternators have been supplied to Adelaide Cement Works. These sets are driven by Premier gas engines, and are interesting

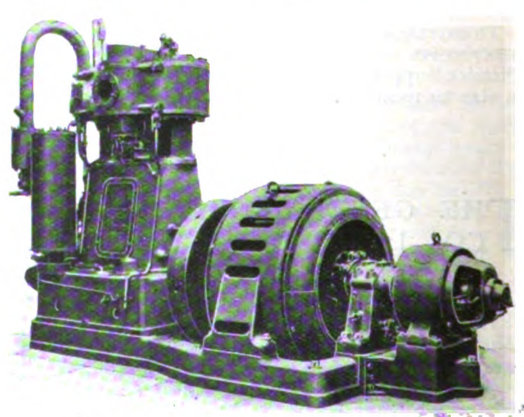


Fig 17.

as the only gas-driven alternators to run in parallel in Australia, and their operation has been entirely satisfactory.

Important work has been undertaken for the municipalities in Australia. Some idea of this type of order is conveyed by Fig. 14, which illustrates a motor generator supplied to the Melbourne Corporation. For this set a repeat order was given after many years of working. In addition considerable work has been done in the smaller towns.

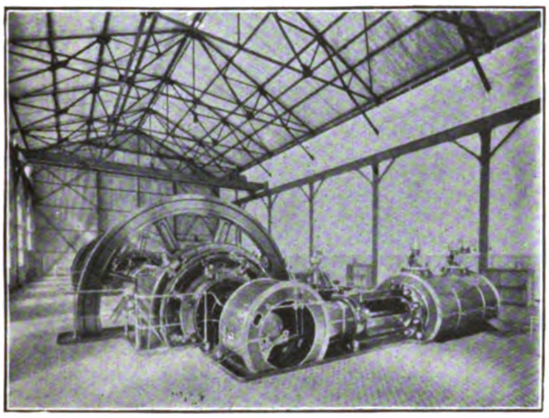


Fig. 18.

INDIA is covered by the General Electric Co. (India), Ltd., with headquarters at Calcutta, and a branch at Madras. This Company has secured many important Government contracts, of which a characteristic example is the plant shown in Figs. 15 and 16. Most electric motors make money for their users, but those depicted in Fig. 16 make it rather more quickly perhaps than do some others. They are installed in the Calcutta Mint, the power plant of which is illustrated in Fig. 15. It comprises three 270 kw. " Witton " C.C. generators driven by Belliss engines; there is, in addition, a complete installation of " Witton " motors.

CHINA.—One of the most important of the G.E.C. Overseas companies is the General Electric Co. of China, Ltd., which is engaged in the heavy competition for the Chinese electrical trade. Headquarters are at Shanghai, with branches at Hong Kong and Hankow.

A considerable number of complete electrical equipments for Chinese towns—for instance Fatshan, Soochow, Ningpo and Yangchow—have been undertaken by this Company. Fig. 17 represents a typical engine set for the purpose of lighting the town of Ningpo. It is driven by a Belliss engine.

Fig. 19.

In SOUTH AMERICA the Argentine is covered by the Anglo-Argentine General Electric Co., Ltd., of Buenos Aires and Chili, and other territories by Messrs. Huth & Co., of Valparaiso and other towns. Amongst the important plants installed by the G.E.C. may be mentioned the complete equipment of the power house of the large Chilian Naval Dockyard at Talcahuano, and the installation at the Concepcion Flour Mills,—whilst in Brazil, G.E.C. machines are working in the Manaos power house shown in Fig. 18.

A " Witton " plant installed nearer home will be observed in Fig. 19. This is a complete rotary converter installation supplied for driving the Barcelona Tramways.

FRANCE is covered by the General Electric de France, and BELGIUM by the G.E.C. of Belgium.

The foregoing remarks will give some idea of the overseas activities of the G.E.C. When, after the war, the home works are able to devote themselves to the huge volume of export trade, it is certain that the G.E.C. overseas selling organization will be able to handle the trade and to divert it into British channels.

LANCASHIRE DYNAMO AND MOTOR CO., LTD.

DRIVING OF SLOW SPEED MACHINERY

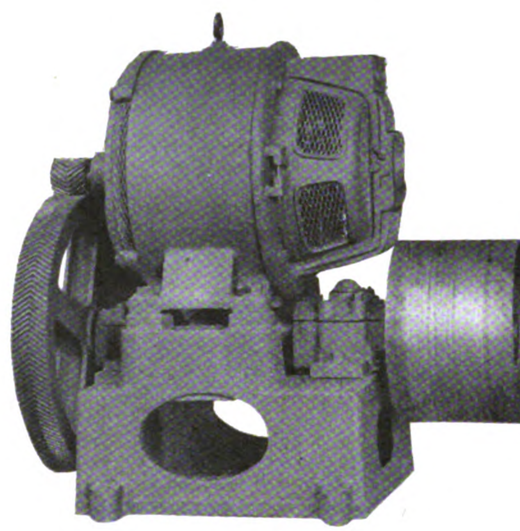


Fig. 20.

Motors lend themselves admirably to individual machine driving in factories, and are now largely employed.

The price of an electric motor to develop a given power is governed largely by the speed, and to ensure low capital charges on an installation it is necessary to use high or moderately high-speed motors. Besides costing less, the high-speed motor has usually a much higher efficiency than one of low speed, and gives a corresponding saving in the power bill.

Where an alternating current is supplied, it is more important still to use a high-speed motor in order to keep a reasonable power factor, as well as to obtain the other advantages as named.

Recent years have witnessed a great increase in the running speed of productive machines, but still the speed is relatively slow when compared with that at which a modern motor will satisfactorily operate. Also certain machines

must necessarily run slowly in order to suit the operations carried out.

Thus it is advisable in many cases to use some form of speed reduction gear between the motor shaft and that of the driven machine. Belts, ropes, chains, gears or combinations of these are available for this purpose, but which of these methods is to be preferred can only be decided by a careful consideration of each individual case.

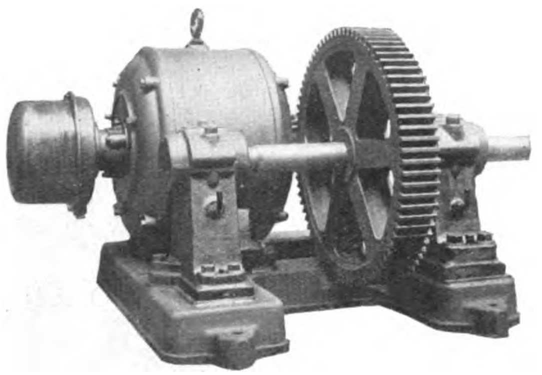


Fig. 21.

Where a belt, rope or chain drive is in use, an ordinary motor with sliding base will be found suitable, but where gearing is employed, it will be found advantageous to make the unit self-contained, and the gears may be mounted on top, under or alongside the motor frame. *With top gear*, a bracket bolted to the motor shell carries the second motion shaft, the belt pull being transmitted through these to the motor foundation bolts—a poor mechanical job which should be rarely used.

Fig. 20 shows a direct current motor with under-type reduction gear, and Fig. 21 shows an induction motor with gears mounted alongside. Either of these arrangements is preferable to the top gear, as both first and second motion shafts are near the foundations, resulting in minimum vibration and greater stability.

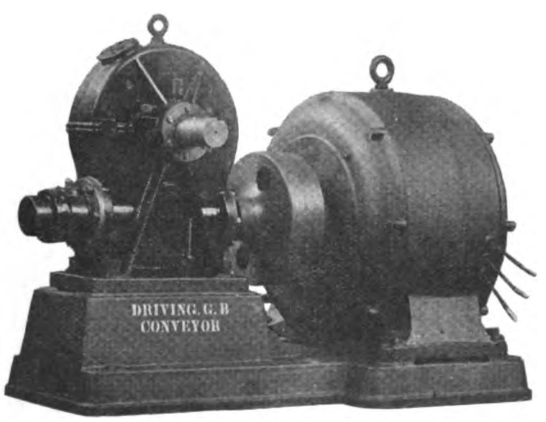


Fig. 22.

The plant illustrated was made at the works of The Lancashire Dynamo & Motor Company, Trafford Park, Manchester, this firm having standardized these gears, which are supplied with either D.C. or A.C. motors. Speed reductions up to 7 to 1 may be obtained with ordinary spur gears, and up to 11 to 1 with double helical gears.

Where a large ratio of speed reduction is required, a worm gear may be employed as shown in Fig. 22.

A. P. LUNDBERG & SONS.

A. P. Lundberg & Sons have had their well-known publication, " Lektrik Lighting Connections," translated and published in French, under the title " Lektrik Schémas de Lumière."

It is contained in a bright khaki cover, and is issued in a handy waistcoat pocket size. The little volume will enable many French-speaking electrical men in other countries, as well as France, to become acquainted with what is generally termed Electric-Light Switching. This may otherwise be described as the use of special tumbler switches for doing all sorts of wonderful and useful things with the light of the lamps, to which they are connected.

With the exception of three items which do not concern foreign readers, the French booklet contains all that is to be found in the English edition ; and the French edition brings the total number printed up to 37,000 copies.

The publication will be sent post free to any part of the world, on prepayment of 1 franc (or equivalent) to the firm, at 477-489, Liverpool Rd., London, N.

A NEW LUNDBERG PUBLICATION.

Those who may have found the numerous diagrams in Messrs. A. P. Lundberg & Sons' booklet " Lektrik Lighting Connections " somewhat bewildering to start with, will welcome the same firms' just-issued publication " Tumbler Switch Controls."

Fig. 23.

This little 48 pp. pamphlet is profusely illustrated with a number of original and easily understood diagrams, accompanied by concise and lucid descriptive matter. The publication, in fact, conveys very clearly all that the non-technical user of electric-light requires to know on the subject, and will also be of use to the busy technical man.

The two dialogues at the end are full of humour, as well as instructive, and the whole is got up in first-class style.

The publication is sent free to anyone who cares to apply for it to Messrs. Lundberg at 477-489, Liverpool Road, London, N.

WESTINGHOUSE SWITCHBOARD INSTRUMENTS.

Instrument manufacture demands a very specialized knowledge and considerable research before satisfactory apparatus can be supplied, and many manufacturers of switchboards, etc., hesitate before entering into a field which may necessitate large expenditure with possibly doubtful results.

A firm, therefore, manufacturing switchboards as well as instruments, naturally find themselves in a very favourable position, since the utmost co-operation between the engineers is possible, ensuring the satisfactory solution of the various difficulties met with, and every confidence can be placed in the final production.

The British Westinghouse Electric & Manufacturing Company, Limited, in order to obtain true co-ordination in the various parts of an installation, manufacture

Fig. 24.
BRITISH WESTINGHOUSE INDUCTION AMMETER, TYPE F.

along with their heavier electrical machinery, complete lines of instruments and meters of all types.

Fig. 25.
BRITISH WESTINGHOUSE SECTOR TYPE VOLTMETER,

In recent years the induction type of indicating instrument has been recognised as the most satisfactory instrument for switchboard and commercial usage.

Fig. 26
BRITISH WESTINGHOUSE POWER FACTOR METER, TYPE F.

The line of type "F" instruments of the British Westinghouse Electric & Manufacturing Co., Ltd., is probably the most complete of its kind, as it includes :—

Ammeters,
Voltmeters,
Wattmeters,
Power Factor Meters,
Frequency Meters,
Synchronscopes,
Static Ground Detectors.

Illustrations of some of these various instruments are shown. It will be noted that they all present a handsome appearance and are of symmetrical design. This enhances the appearance of any switchboard and, as the line of instruments is complete, it is not necessary

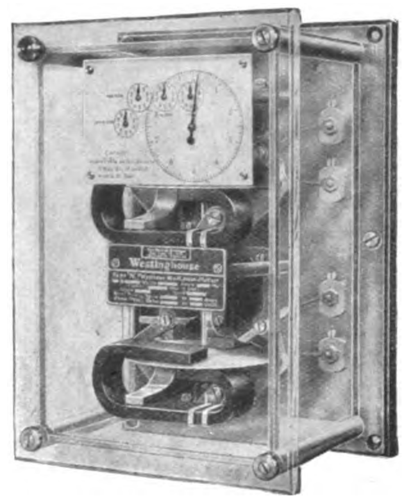


Fig. 27.
BRITISH WESTINGHOUSE UNBALANCED POLYPHASE, TYPE N, WATT-HOUR METER, SWITCHBOARD TYPE, WITH SPECIAL POINTER DIAL.

to install other makes of special instruments and so spoil the symmetry.

Besides developing the type "F," which are large dial, long scale instruments, the Company fully appreciated the necessity for moving iron instruments for use in ordinary commercial situations. The Westinghouse design of this type of instrument possesses certain characteristics not obtainable in other types of moving iron instruments, and the instruments are of a less expensive construction than the induction

Fig. 28.
BRITISH WESTINGHOUSE, TYPE P, OVERLOAD TIME LIMIT, DOUBLE POLE RELAY.

type. These instruments, known as type "SB," are made in round, sector, and edgewise patterns; they are extremely dead beat and the scale practically uniform from 10 per cent. upwards.

For continuous currents (type "R" instrument) the D'Arsonval principle is utilized, great attention being paid to the manufacture of the magnet, which latter decides whether the instrument is to be satisfactory or not. All permanent magnets used on their instruments and meters are made throughout at the B.W.E. & M. Co., Ltd.'s, Works, Manchester. They are carefully hardened, magnetized and aged, thus

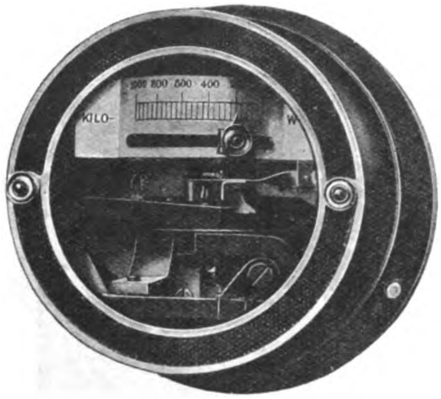


Fig. 29.

BRITISH WESTINGHOUSE, TYPE N, INSTANTANEOUS REVERSE RELAY.

allowing the Company to be independent entirely of steel magnet makers, who were more often than not foreign companies.

The instrument makers who specialize in the manufacture of instruments only rarely manufacture relays and the same may be said of integrating meters (Watt-hour meters), which are made almost exclusively by meter manufacturing companies.

The switchboard builder has, therefore, to select his instruments at one firm, his relays at another, or else make them himself, and his integrating meters at another.

Here the B.W.E. & M. Co., Ltd., are at a distinct advantage, for they can supply all classes of relay, from solenoid to induction types, direct or alternating, instantaneous or time limit.

Similarly, integrating meters, whether ampère hour, watt hour, direct or alternating, house service or switchboard, can be supplied with a finish suitable to the class of instrument required.

A few of the more typical styles are shown, but many other designs are available, and it can be confidently asserted that practically any engineer's requirements can be met.

The relays are of robust construction and have been proved in operation after exhaustive tests had been made in our own works with our own switchgear and all practical difficulties overcome.

In the case of the integrating meters, the various modifications, such as "two-rate" Maximum Demand, Differential Meters, etc., etc., all have been successfully developed and exploited on markets at home and abroad.

The experience gained therefore by the B.W.E. & M. Co., Ltd., is more or less unique and enables the Company to supply apparatus of first-class design, manufacture and reliability.

WE are seldom satisfied with our methods. There is always a newer and a better way to do things. Inventions never cease, and industry requires constant vigilance to keep machinery up-to-date and to reduce unnecessary waste in power and repairs. Counted one against the other, the cost of installing the best machinery of newest design is less than the cost entailed by using antiquated, worn-out plant. The power expense is reduced, repairs are minimized, stoppages are less frequent and labour is fully utilized; also, intelligent workmen give their best energies when the work is interesting and associated with the newest machinery on the market.

The articles contributed to the ***Manufacturers' Section*** of this issue of THE BEAMA JOURNAL describe some of the latest and best installations in the Electrical line and should be read by practical engineers and organizers of industries.

A business that is conducted in departments with non-communicating walls usually fails to make the best of workpeople, organizers or machinery. Factory deficiency hinders the salesmen; inefficiency in one department cannot be made good except at the expense of another department; wages cannot be increased when there is waste caused by using old machinery; dividends gradually drop, and reserves for improvements cannot be accumulated.

Poor machinery thus operates to produce a vicious circle in which an industrial establishment will gradually become a cypher.

CLASSIFIED DIRECTORY OF MANUFACTURES

MANUFACTURES OF MEMBERS. PRODUCTIONS DES ASSOCIES. PRODUCCIONES DE LOS SOCIOS
ПРОИЗВОДСТВА УЧАСТВУЮЩИХЪ ФИРМЪ.

ACCESSORIES for Power, Lighting, Bells and Signalling.
ACCESSOIRES pour Force Motrice, Eclairage, Sonneries et Signaux.
ACCESORIOS para Fuerza Motriz, Alumbrado, Campanillas y Señales.
ПРИНАДЛЕЖНОСТИ для Двигателей, Освѣщенія, Звонковъ и Сигналовъ.

Bells (for bell wires, see under "Wires").
Sonneries (pour fils de sonneries, voir "Fils").
Campanillas (para alambres de campanillas, véase "Alambres").
Звонки (звонк. провода, см. „Провода").

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SANDYCROFT LTD.
SIEMENS BROS. & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Casing and Capping.
Moulures pour Fils.
Cajetines para Alambres.
Рейки для Проводовъ.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Roses.
Rosaces de Plafond.
Rosetones de Techo.
Потолочныя Розетки.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Cut-outs.
Coupe-Circuits.
Cortacircuitos.
Предохранители.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ERSKINE, HEAP & CO., LTD.
GENERAL ELECTRIC CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
IGRANIC ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Indicators.
Indicateurs.
Indicadores.
Индикаторы.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
NALDER BROS. & THOMPSON, LTD.
REASON MANUFACTURING CO., LTD.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Lampholders.
Douilles.
Portalámparas.
Патроны.

BERRY, SKINNER & CO.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Plugs and Sockets.
Fiches et Prises de Courant.
Llaves y Cajas de Contacto.
Контачныя Штепселя и Коробки.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Pushes.

Boutons de Poussoirs.

Botones de Llamada.

Звонковыя Кнопки.

BERRY, SKINNER & CO.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Tumbler Switches.

Interrupteurs à Boule.

Llaves de Concha.

Выключатели съ опрок. головкой.

BERRY, SKINNER & CO.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUNDBERG, A. P., & SONS.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Wood Blocks.

Tampons en Bois.

Tacos de Madera.

Деревянные Закрѣпы.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Accessories for accumulators, arc lamps, batteries, telephones, etc., see under those headings.

Accessoires pour accumulateurs, lampes à arc, batteries, téléphones, etc., voir ces mots.

Accesorios para acumuladores, lámparas de arco, baterias, teléfonos, etc., véanse estas palabras.

Принадлежности для аккумуляторовъ, дуговыхъ лампъ, батарей, телефоновъ, и пр., см. эти слова.

ACCUMULATORS.

ACCUMULATEURS.

ACUMULADORES.

АККУМУЛЯТОРЫ.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
D.P. BATTERY CO., LTD.
TUDOR ACCUMULATOR CO., LTD.
PRITCHETTS & GOLD AND ELECTRIC POWER STORAGE CO., LTD.

Accumulator Switches and Switchboards, see under "Switchgear."

Commutateurs et Tableaux de Distribution pour Accumulateurs, voir "Appareils de Distribution."

Conmutadores y Cuadros de Distribución para Acumuladores, véase "Aparatos de Distribución."

Аккумуляторные Коммутаторы и Распредѣлительныя доски, см. „Распредѣлительныя Устройства".

ACCUMULATORS (Heat, Regenerative).

ACCUMULATEURS de Chaleur Régénérative.

ACUMULADORES de Calor Regenerativo.

АККУМУЛЯТОРЫ Регенеративаго Тепла.

RICHARDSONS, WESTGARTH & CO., LTD.

AIR COMPRESSORS, see "Compressors."

COMPRESSEURS d'AIR, voir "Compresseurs."

COMPRESORES de AIRE, véase "Compresores."

ВОЗДУШНЫЕ КОМПРЕССОРЫ, см. „Компрессоры".

AIR FILTERS.

Filtres d'Air.

Filtros de Aire.

Воздушные Фильтры.

PREMIER COOLER & ENGINEERING CO., LTD.

ALTERNATORS, see "Generators."

ALTERNATEURS, voir "Génératrices."

ALTERNADORES, véase "Generadores."

АЛЬТЕРНАТОРЫ, см. „Генераторы".

ARC LAMPS and Accessories.

LAMPES à ARC et Accessoires.

LAMPARAS de ARCO y Accesorios.

ДУГОВЫЯ ЛАМПЫ или ФОНАРИ и Принадлежности.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Standards.

Poteaux de Lampes à Arc.

Columnas de Lámparas de Arco.

Столбы для Дуговыхъ Лампъ.

BERRY, SKINNER & CO.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Winches.

Treuils de Levage pour Lampes à Arc.

Tornos de Elevación para Lámparas de Arco.

Лебедки для Дуговыхъ Лампъ.

CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
REASON MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

Arc Lamp Carbons, see under "Carbons."
Crayons de Lampes à Arc, voir "Crayons."
Carbones para Lámparas de Arco, véase "Carbones."
Угли для Дуговыхъ Лампъ, см. „Угли".
Arc Lamp Globes, see under "Glassware."
Globes de Lampes à Arc, voir "Verreries."
Globos de Lámpara de Arco, véase "Cristaleria."
Шары для Дуговыхъ Лампъ, см. „Стеклянная Посуда".

AUTOMOBILE SWITCHBOARDS.
TABLEAUX de DISTRIBUTION pour AUTOMOBILES.
CUADROS de DISTRIBUCION para AUTOMOVILES.
КОММУТАЦIОННЫЯ ДОСКИ для АВТОМОБИЛЕЙ.
LUNDBERG, A. P., & SONS.

BATTERIES, Primary and Accessories.
BATTERIES, Primaires et Accessoires.
BATERIAS, Primarias y Accesorios.
БАТАРЕИ Первичныя и Принадлежности.

Dry Cells.
Piles Sèches.
Pilas Secas.
Сухіе Элементы.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.
SUN ELECTRICAL CO., LTD.

Ignition Cells.
Piles d'Allumage.
Pilas de encender.
Зажигательныя Батареи.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Wet Cells (Leclanché, etc.).
Piles Hydroélectriques (Leclanché, etc.).
Pilas Hidroeléctricas (Leclanché, etc.).
Мокрые Элементы (Лекланше и др.).
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

BELLS, see under "Accessories."
SONNERIES, voir "Accessoires."
CAMPANILLAS, véase "Accesorios."
ЗВОНКИ, см. „Принадлежности".

BLOWERS, see **COMPRESSORS.**
SOUFFLERIES, voir **COMPRESSEURS.**
SOPLADORES, véase **COMPRESORES.**
ВОЗДУХОДУВКИ, см. **КОМПРЕССОРЫ.**

BOILERS and Boiler Equipments.
CHAUDIERES et Accessoires de Chaudières.
CALDERAS y Accesorios de Calderas.
КОТЛЫ и Котельная Арматура.
CLARKE, CHAPMAN & CO., LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.

BOOSTERS, see under "Generators."
SURVOLTEURS, voir "Génératrices."
ELEVADORES de TENSION, véase "Generadores."
ПОВЫСИТЕЛИ НАПРЯЖЕНIЯ (БУСТЕРЫ), см. „Генераторы".

BRAKES (Magnetic).
FREINS Magnétiques.
FRENOS Magnéticos.
Магнитные ТОРМАЗА.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.

BRUSHES, Carbon, for Electrical Machinery.
BALAIS en Carbone pour Appareils Electriques.
ESCOBILLAS de Carbón para Aparatos Eléctricos.
УГОЛЬНЫЯ ЩЕТКИ для Электрическихъ Машинъ.
MORGAN, CRUCIBLE CO., LTD.

CABLES (see also "Wires") and Cable Accessories.
CÂBLES (voir aussi "Fils") et Accessoires de Câbles.
CABLES (véase también "Alambres") y Accesorios de Cables.
КАБЕЛИ (см. также „Провода") и Принадлежности.

Paper Insulated Cables.
Câbles Isolés au Papier.
Cables Aislados con Papel.
Кабели съ Бумажной Изоляцiей.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Rubber Insulated Cables.
Câbles Isolés au Caoutchouc.
Cables Aislados con Caucho.
Кабели съ Резиновой Изоляцiей.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Submarine Cables.
Câbles Sous-Marins.
Cables Submarinos.
Поводные Кабели.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Telephone Cables.
Câbles Téléphoniques.
Cables Telefónicos.
Телефонные Кабели.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

Junction Boxes.
Boîtes de Dérivation.
Cajas de Derivación.
Отвѣтвительныя Коробки.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ERSKINE, HEAP & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
LUCY, W., & CO.
SIEMENS BROS. & CO., LTD.

Expansion Joints.
Joints Extensibles.
Empalmes Extensibles.
Растяжимыя Соединенія.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
REYROLLE, A. & CO., LTD.
SIEMENS BROS. & CO., LTD.

CARBONS.
CHARBONS.
CARBONES.
УГЛИ.

For Arc Lamps.
Pour Lampes à Arc.
Para Lámparas de Arco.
Для Дуговыхъ Лампъ.
CROMPTON & CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Carbon Brushes, see under " Brushes."
Balais en Carbone, voir " Balais."
Escobillas de Carbón, véase " Escobillas."
Угольныя Щетки, см. ,,Щетки".

Carbon Crucibles, see under " Crucibles."
Creussets en Carbone, voir " Creusets."
Crisoles de Carbón, véase " Crisoles."
Тигли Угольные, см. ,,Тигли".

CEILING ROSES, see under " Accessories."
ROSACES DE PLAFOND, voir " Accessoires."
ROSETONES DE TECHO, véase " Accesorios."
ПОТОЛОЧНЫЯ РОЗЕТКИ, см. ,,Принадлежности".

CELLS, see " Accumulators " and " Batteries."
PILES, voir " Accumulateurs " et " Batteries."
PILAS, véase " Acumuladores " y " Baterías."
ЭЛЕМЕНТЫ, см. ,,Аккумулятроы" и ,,Батареи".

CLOCKS, Electrically driven.
HORLOGES Electriques.
RELOJES Eléctricos.
ЧАСЫ Электрическіе.
ARON ELECTRICITY METER, LTD.
VENNER & CO.

COLLIERIES, Equipment of, see " Mines."
HOUILLERES, Equipements de, voir " Mines."
HULLERAS, Equipos de, véase " Minas."
КАМЕННОУГОЛЬНЫЯ КОПИ, ихъ оборудованіе, см. ,,Рудники".

COMPRESSORS AND BLOWERS.
COMPRESSEURS et SOUFFLERIES.
COMPRESORES y SOPLADORES.
КОМПРЕССОРЫ и ВОЗДУХОДУВКИ.
ALLEN, W. H., SON & CO., LTD.
ALLEY & MACLELLAN, LTD.
BELLISS & MORCOM, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
BROWETT, LINDLEY & CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
PARSONS, C. A., & CO., LTD.
SANDYCROFT LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

CONDENSERS, ELECTRICAL.
CONDENSATEURS ELECTRIQUES.
CONDENSADORES ELECTRICOS.
КОНДЕНСАТОРЫ ЭЛЕКТРИЧЕСКІЕ.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
GENERAL ELECTRIC CO., LTD.
HICK, HARGREAVES & CO., LTD.
JOHNSON & PHILLIPS, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
SIEMENS BROS. & CO., LTD.

CONDENSERS, STEAM.
CONDENSEURS de VAPEUR.
CONDENSADORES de VAPOR.
КОНДЕНСАТОРЫ ПАРОВЫЕ.

ALLEN, W. H., SON & CO., LTD.
ASHWORTH & PARKER.
BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
HICK, HARGREAVES & CO., LTD.
MIRRLEES WATSON CO., LTD
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

CONDUITS and Conduit Fittings.
TUBES ISOLANTS et Accessoires pour Tubes.
TUBOS AISLADORES y Accesorios para Tubos.
ИЗОЛЯЦIОННЫЯ ТРУБКИ и ихъ Принадлежности.

CREDENDA CONDUITS CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

CONTROL GEAR.
APPAREILS CONTROLEURS.
APARATOS DE COMPROBACION.
КОНТРОЛЬНЫЕ АППАРАТЫ.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTRIC CONTROL LTD. (Automatic Control Gear only).
ELECTRICAL APPARATUS CO., LTD.
ELLISON, GEORGE.
ERSKINE, HEAP & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REYROLLE & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
WEST, ALLEN, & CO., LTD.
WHIPP & BOURNE.

Controllers for Crane Motors.
Contrôleurs pour Moteurs de Grues.
Controleres para Motores de Grúas.
Контролеры для Крановыхъ Моторовъ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELLISON, GEORGE.
ERSKINE, HEAP & CO., LTD.
IGRANIC ELECTRIC CO., LTD.
WEST, ALLEN, & CO., LTD.

Controllers for Traction Work.
Contrôleurs pour Moteurs de Tramway.
Controleres para Motores de Tranvia.
Контролеры для Трамвайныхъ Моторовъ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
ELLISON, GEORGE.
ERSKINE, HEAP & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
WEST, ALLEN, & CO., LTD

Motor Starters and Panels.
Démarreurs et Tableaux de Démarrage pour Moteurs.
Aparatos y Cuadros de Arranque para Motores.
Пусковые Аппараты и Доски для Моторовъ.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
MORRIS & LISTER, LTD.
REYROLLE, A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Rheostats.
Rhéostats.
Reostatos.
Реостаты.

BERRY, SKINNER & CO.,
BOOTHROYD, H. T., LTD.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ERSKINE, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLIOTT BROTHERS.
ELLISON, GEORGE.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
NALDER BROS. & THOMPSON, LTD.
PAUL, ROBERT W.
REYROLLE, A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WEST, ALLEN, & CO., LTD.
WHIPP & BOURNE.

CONVERTERS (Motor).
TRANSFORMATEURS en CASCADE.
TRANSFORMADORES en CASCADA.
КАСКАДНЫЕ КОНВЕРТЕРЫ.

(PEEBLES—LA COUR PATENTS).
PEEBLES, BRUCE, & CO., LTD.

CONVERTERS, ROTARY.
COMMUTATRICES.
CONVERTIDORES ROTATORIOS.
ВРАЩАЮЩIЕСЯ КОНВЕРТЕРЫ (ПРЕОБРАЗОВАТЕЛИ).

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.
WRIGHT & WOOD, LTD.

Converters, Static, see "Transformers."
Transformateurs Statiques, voir "Transformateurs."
Transformadores Estáticos, véase "Transformadores."
Статическiе Преобразователи, см. ,,Трансформаторы".

COOKING APPLIANCES ELECTRICAL, see "Heating and Cooking."
USTENSILES ELECTRIQUES de CUISINE, voir "Chauffage et Cuisine."
UTENSILIOS ELECTRICOS de COCINA, véase "Caldeo y Cocina."
ЭЛЕКТРИЧЕСКIЕ КУХОННЫЕ ПРИБОРЫ, см. ,,Отопленiе и Кухонные Приборы".

CRANE EQUIPMENTS, see also "Control Gear," "Motors," etc.
EQUIPEMENT DE GRUES, voir aussi "Appareils Contrôleurs," "Moteurs," etc.
EQUIPOS DE GRUAS, véase también "Aparatos de Comprobación," "Motores," etc.
СНАРЯЖЕНIЕ для КРАНОВЪ, см. также ,,Контрольные Аппараты", ,,Моторы" и пр.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
ERSKINE, HEAP & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
ELLISON, GEORGE.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JANDUS ARC LAMP & ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WEST, ALLEN, & CO., LTD.

CRUCIBLES, Electric.
CREUSETS Electriques.
CRISOLES Eléctricos.
ТИГЛИ Электрическiе.

MORGAN CRUCIBLE CO., LTD.

CUT-OUTS, see "Accessories."
COUPE-CIRCUITS, voir "Accessoires."
CORTACIRCUITOS, véase "Accesorios."
ПРЕДОХРАНИТЕЛИ, см. ,,Принадлежности".

DISTRIBUTION BOARDS, see also "Switchgear."
TABLEAUX DE DISTRIBUTION, voir aussi "Appareils de Distribution."
CUADROS DE DISTRIBUCION, véase también "Aparatos de Distribución."
РАСПРЕДѢЛИТЕЛЬНЫЯ ДОСКИ, см. также ,,Распредѣлительныя Устройства".

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ERSKINE, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
SWITCHGEAR & COWANS, LTD.

DOMESTIC APPLIANCES, see also "Heating and Cooking," "Fans," etc.
APPAREILS DOMESTIQUES, voir aussi "Chauffage et Cuisine," "Ventilateurs," etc.
APARATOS DOMESTICOS, véase también "Caldeo y Cocina," "Ventiladores," etc.
ДОМОВЫЯ УСТАНОВКИ, см. также ,,Отопленіе и Освѣщеніе", ,,Вентиляторы" и пр.

BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
SUN ELECTRICAL CO., LTD.

Vacuum Cleaners.
Nettoyeuses au Vide.
Limpiadores de Vacio.
Пылесосы.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.

DRILLS, Electrically driven.
FOREUSES Electriques.
PERFORADORES Eléctricos.
Электрическіе СВЕРЛИЛЬНЫЕ СТАНКИ.

BOOTHROYD, H. T., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.

Portable Drilling Machines.
Foreuses Portatives.
Perforadores Portátiles.
Переносные Сверлильные Станки.

BOOTHROYD, H. T., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
REES ROTURBO MANUFACTURING CO., LTD.

DYNAMOS, see "Generators."
DYNAMOS, voir "Génératrices."
DINAMOS, véase "Generadores."
ДИНАМО, см. ,,Генераторы".

ENGINES, see "Prime Movers."
MACHINES, voir "Machines Motrices."
MAQUINAS, véase "Máquinas Motoras."
ДВИГАТЕЛИ, см. это слово.

FANS.
VENTILATEURS.
VENTILADORES.
ВЕНТИЛЯТОРЫ.

Bracket Fans.
Ventilateurs à Console.
Ventiladores de Consola.
Консольные Вентиляторы.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Fans.
Ventilateurs de Plafond.
Ventiladores de Techo.
Потолочные Вентиляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO.
SUN ELECTRICAL CO., LTD.

Table Fans.
Ventilateurs de Table.
Ventiladores de Mesa.
Настольные Вентиляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.

PARSONS, C. A., & CO.
SUN ELECTRICAL CO., LTD.

Ventilating Fans.
Ventilateurs Extracteurs.
Ventiladores Extractores.
Вытяжные Вентиляторы.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
HOWDEN, JAMES, & CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARSONS, C. A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

FITTINGS for Electric Light.
ACCESSOIRES pour Lumière Electrique.
ACCESORIOS para Luz Eléctrica.
ПРИНАДЛЕЖНОСТИ для Электрическаго Свѣта.

Brackets.
Appliques.
Brazos.
Кронштейны.

BRITISH THOMSON-HOUSTON CO., LTD.
CREDENDA CONDUITS CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Ceiling Fittings.
Accessoires de Plafond.
Accesorios de Techo.
Потолочныя Гарнитуры.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Counterweights.
Contrepoids.
Contrapesos.
Противовѣсы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Electroliers.
Lustres.
Arañas.
Люстры.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO. LTD

Fancy Shades.
Abat-Jour Artistiques.
Pantallas Artisticas.
Декоративные Абажуры.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Hand Lamps.
Lampes à Main.
Lámparas de Mano.
Ручныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Lanterns.
Lanternes.
Linternas.
Фонари.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Pendants.
Lampes à Suspension.
Lámparas de Suspensión.
Подвѣсныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Reflectors.
Reflecteurs.
Reflectores.
Рефлекторы.

BRITISH THOMSON-HOUSTON CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
DAY, ST. JOHN (PATENTS), LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PARSONS, C. A., & CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Standard Lamps.
Lampes Portatives.
Lámparas Portátiles.
Переносныя Лампы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.

SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Street Fittings.
Matériel pour Eclairage Public.
Material para Alumbrado Público.
Матеріалъ для Уличнаго Освѣщенія.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
REASON MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Watertight Fittings for Mines, Dockyards, Shipwork, etc.
Accessoires Hermétiques pour Mines, Chantiers de Construction Navale, Navires, etc.
Accesorios Erméticos para Minas, Astilleros Buques, etc.
Водонепроницаемыя Устройства для Рудниковъ, Верфей, Судовъ и пр.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
LUCY, W., & CO.
REASON MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

Carbons for Electric Furnaces, see "Carbons."
Electrodes pour Fours Electriques, voir "Crayons."
Electrodes para Hornos Eléctricos, véase "Carbones."
Электроды для Электрическихъ Печей, см. „Угли".

FUSES.
FUSIBLES.
FUSIBLES.
ЛЕГКО-ПЛАВКІЯ ВСТАВКИ.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC CONTROL, LTD. (High Tension).
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ERSKINE, HEAP & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
LUCY, W., & CO., LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REASON MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

GENERATORS, A.C. and D.C.
GENERATRICES, à C.C. et à C.A.
GENERADORES, de C.C. y C.A.
ГЕНЕРАТОРЫ Пост. и Перем. Тока.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PARSONS, C. A., & CO., LTD
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Boosters.
Survolteurs.
Elevadores de Tensión.
Повыситель Напряженія (Бустеры).

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Generators for Electro-Plating.
Génératrices pour Galvanoplastie.
Generadores para Galvanoplastia.
Генераторы для Гальванопластики.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.

MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Motor-Generators.
Moteurs-Générateurs.
Motores-Generadores.
Двигатели-Генераторы.

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD
SIEMENS BROS. DYNAMO WORKS, LTD.
SANDYCROFT, LTD.
VICKERS, LTD.

Turbo-Alternators.
Turbo-Alternateurs.
Turbo-Alternadores.
Турбо-Альтернаторы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Continuous Current Turbo-Generators.
Turbo-Génératrices à Courant Continu.
Turbo-Dinamos de Corriente Continua.
Турбо-Генераторы Пост. Тока.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
MATHER & PLATT, LTD.
GREENWOOD & BATLEY, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAWO WORKS, LTD.
VICKERS, LTD.

GLASSWARE.
VERRERIES.
CRISTALERIA.
СТЕКЛЯННАЯ ПОСУДА.

Arc Lamp Globes.
Globes de Lampes á Arc.
Globos de Arco.
Шары для Дуговыхъ Лампъ.

Glass Shades.
Abat-Jour en Verre.
Pantallas de Vidrio.
Стеклянные Абажуры.

Holophane Ware.
Verreries Holophanes.
Cristaleria Holófana.
Голофанная Посуда.

MOST MEMBERS OF THE B.E.A.M.A. SELL THESE WARES.

HEATING AND COOKING APPLIANCES, Electrical.
APPAREILS Electriques de **CHAUFFAGE** et de **CUISINE.**
APARATOS Eléctricos de **CLADEO** y de **COCINA.**
Электрическіе **НАГРѢВАТЕЛЬНЫЕ и КУХОННЫЕ ПРИБОРЫ.**

CREDENDA CONDUITS CO., LTD.
BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

Radiators, see this word under main headings.
Radiateurs, voir ce mot.
Radiadores, véase esta palabra.
Радіаторы, см. это слово.

INCANDESCENT LAMPS, see "Lamps."
LAMPES à INCANDESCENCE, voir "Lampes."
LAMPARAS de INCANDESCENCIA, véase "Lámparas."
ЛАМПЫ НАКАЛИВАНІЯ, см. „Лампы„.

INDUCTION COILS, see "Medical Electro-Appliances" and "Wireless Telegraphy Appliances."
BOBINES d'INDUCTION, voir "Appareils Electro-Médicaux" et "Appareils de Télégraphie sans Fil."
CARRETES de INDUCCION, véase "Aparatos Eléctro-Medicales" y "Aparatos de Telegrafía sin Alambres."
ИНДУКЦІОННЫЯ КАТУШКИ, см. „Электро-Медицинскіе Аппараты" и „Радіо-Телеграфные Аппараты".

INSTRUMENTS, see also "Testing Sets."
INSTRUMENTS, voir aussi "Appareils de Laboratoire."
INSTRUMENTOS, véase también "Aparatos de Laboratorio."
ИНСТРУМЕНТЫ, см. также „Приборы для Испытанія".

Indicating Instruments (Ammeters, Voltmeters, Wattmeters, Phasemeters, Frequency Indicators, etc.).
Instruments de Mesure (Ampèremètres, Voltmètres, Wattmètres, Phasemètres, Fréquencemètres, etc.).
Instrumentos de Medida (Amperómetros, Voltímetros, Vatímetros, Fasómetros, Frecuencímetros, etc.).

Контрольные Аппараты (Амперметры, Вольтметры, Ваттметры, Фазометры, Частометры и др.).

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ERSKINE, HEAP & CO., LTD
ELLIOTT BROTHERS.
EVERETT, EGDCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. & CO., LTD.

Instrument Transformers.
Transformateurs de Mesure.
Transformadores de Medida.
Измѣрительные Трансформаторы.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ERSKINE, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SWITCHGEAR & COWANS, LTD.

Recording Instruments.
Instruments Enregistreurs.
Instrumentos Registradores.
Самопишущіе Приборы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ERSKINE, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.

Instruments, Integrating, see "Meters."
Compteurs Totalisateurs, voir "Compteurs."
Contadores Integradores, véase "Contadores."
Счетчики-Интеграторы, см. „Счетчики".

INSULATORS.
ISOLATEURS.
AISLADORES.
ИЗОЛЯТОРЫ.

Porcelain Insulators.
Isolateurs en Porcelaine.
Aisladores de Porcelana.
Фарфоровые Изоляторы.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
IGRANIC ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Suspension Insulators.
Isolateurs de Suspension.
Aisladores ed Suspensión.
Подвѣсные Изоляторы.

BRITISH THOMSON-HOUSTON CO., LTD
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
SIEMENS BROS. & CO., LTD.

Tramway Insulators for Overhead Lines.
Isolateurs de Tramway pour Lignes Aériennes.
Aisladores de Tranvia para Líneas Aéreas.
Изоляторы для Трамвайныхъ Воздушныхъ Линій.

BRITISH INSULATED & HELSBY CABLES, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.

INSULATING MATERIAL.
MATIERES ISOLANTES.
MATERIALES AISLANTES.
ИЗОЛЯЦІОННЫЕ МАТЕРІАЛЫ.

Press Spahn and other Materials.
Cartons Comprimés et autres Matières.
Cartones Comprimidos y otros Materiales.
Прессованные Картоны и др. Матеріалы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
DAY, ST. JOHN (PATENTS), LTD.
ERSKINE, HEAP & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PIRELLI, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

JUNCTION BOXES, see "Cables" and "Conduits."

BOITES de DERIVATION, voir "Cables" et "Tubes Isolants."

CAJAS de DERIVACION, véase "Cables" y "Tubos Aisladores."

ОТВѢТВИТЕЛЬНЫЯ КОРОБКИ, см. ,,Кабели" и ,,Изолиц. Трубки".

LAMPS, see also "Arc Lamps."

LAMPES, voir aussi "Lampes à Arc."

LAMPARAS, véase también "Lámparas de Arco."

ЛАМПЫ, см. также ,,Дуговыя Лампы".

Incandescent Lamps (Carbon Filament, Metallic Filament and Drawn Wire Lamps).

Lampes à Incandescence (á Filament en Carbone, á Filament Métallique et à Fil Etiré).

Lámparas de Incandescencia (con Filamento de Carbón, Filamento metálico, y con Alambre Estirado).

Лампы Накаливанія (съ Угольной Нитью, Металлической Нитью и съ Тянутой Проволокой).

BRITISH THOMSON-HOUSTON CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL ENGINEERING & EQUIPMENT CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
OSRAM-ROBERTSON LAMP WORKS, LTD.
SIEMENS BROS. & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

LAMPHOLDERS, see "Accessories."

DOUILLES, voir "Accessoires."

PORTALAMPARAS, véase "Accesorios."

ПАТРОНЫ, см. ,,Принадлежности".

LANTERNS, see "Fittings."

LANTERNES, voir "Garnitures."

LINTERNAS, véase "Guarniciones."

ФОНАРИ, см. ,,Гарнируры".

LIFT MOTORS, see "Motors."

MOTEURS d'ASCENSEURS, voir "Moteurs."

MOTORES PARA ASCENSORES, véase "Motores."

ПОДЪЕМНЫЕ МОТОРЫ, см. ,,Моторы".

LIGHTNING ARRESTERS.

PARAFOUDRES.

PARARRAYOS.

ГРОМООТВОДЫ.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
ERSKINE, HEAP & CO., LTD.
EVERETT, EDGCUMBE & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.

MAGNETOS.

MAGNÉTOS.

MAGNETOS.

МАГНЕТА.

BRITISH THOMSON-HOUSTON CO., LTD.

MAGNETS, LIFTING.

ELECTRO-AIMANTS.

ELECTRO-IMANES.

ЭЛЕКТРО-МАГНИТЫ.

ELECTRIC CONTROL, LTD.
ERSKINE, HEAP & CO., LTD
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
MORRIS & LISTER, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.

MAGNETS, PERMANENT.

AIMANTS PERMANENTS.

IMANES PERMANENTES.

ПОСТОЯННЫЕ МАГНИТЫ.

NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.

MEDICAL, ELECTRO-APPLIANCES.

APPAREILS ELECTRO-MEDICAUX.

APARATOS ELECTRO-MEDICALES.

ЭЛЕКТРО-МЕДИЦИНСКИЕ АППАРАТЫ.

Induction Coils.

Bobines d'Induction.

Carretes de Inducción.

Индукціонныя Катушки.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

X-Ray Outfits.

Radiomètres pour Rayons X.

Radiómetros para Rayos Roentgen.

Приборы для Рентгеновскихъ Лучей.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. & CO., LTD.

METERS.

COMPTEURS.

CONTADORES.

СЧЕТЧИКИ.

ARON ELECTRICITY METER, LTD.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

Ampère-Hour Meters.

Ampères-Heures-Mètres.

Contadores de Amperios-Horas.

Счетчики Амперъ-Часовъ.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

Watt-Hour Meters.

Watts-Heures-Mètres.

Contadores de Vatio-Horas.

Счетчики Ваттъ-Часовъ.

ARON ELECTRICITY METER, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CHAMBERLAIN & HOOKHAM, LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
FERRANTI, LTD.
NALDER BROS. & THOMPSON, LTD.
REASON MANUFACTURING CO., LTD.
VENNER & CO.

MINES, Equipments for.

Equipement pour **MINES.**

Equipos para **MINAS.**

РУДНИЧНЫЯ Оборудованія.

BERRY, SKINNER & CO.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ERSKINE, HEAP & CO., LTD.
FRASER & CHALMERS, LTD.
GLOVER, W. T., & CO., LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
VICKERS, LTD.
WEST, ALLEN, & CO., LTD.

Flameproof Motors.

Moteurs Etanches au Gaz.

Motores Estancos al Gas.

Газонепроницамые Безопасные Моторы.

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD
CROMPTON & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILSON-WOLF ENGINEERING CO., LTD

Haulage Gear.

Appareils de Halage.

Aparatos de Tracción.

Транспортныя Устройства.

BRITISH ELECTRIC PLANT CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PARSONS, C. A., & CO., LTD.
SANDYCROFT, LTD.
VICKERS, LTD.

Winding Engines.

Machines d'Extraction.

Máquinas de Extracción.

Рудничныя Лебедки.

BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
FRASER & CHALMERS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Mine and Watertight Fittings, see " Fittings for Electric Light."

Accessoire Etanches pour Mines, voir " Accessoires pour Lumière Electrique."

Accesorios Estancos para Minas, véase "Accesorios para Luz Eléctrica."

Рудничныя Водонепроцинаемыя Принадлежности, см. ,,Принадлежности для Электр. Освѣщ''.

Mining Switchgear, see "Switchgear."

Appareils de Distribution pour Mines, voir "Appareils de Distribution."

Aparatos de Distribución para Minas, véase "Aparatos de Distribución."

Рудничныя Распредѣлительныя Устройства, см. „Распр. Устройства".

Mine and Sinking Pumps, see "Pumps."

Pompes d'Exhaure pour Mines, etc., voir "Pompes."

Bombas para Minas, Pozos, etc., véase "Bombas."

Рудничные и Артезіанскіе Насосы, см. „Насосы".

Miners' Safety Lamps, see "Lamps."

Lampes de Sûreté de Mineurs, voir "Lampes."

Lámparas de Seguridad de Mineros, véase "Lámparas."

Рудничныя Лампы, см. „Лампы".

MOTORS for A.C. and D.C.

MOTEURS pour C.C. et C.A.

MOTORES para C.C. y C.A.

МОТОРЫ для Перем. и Пост. Тока.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Crane Motors.

Moteurs de Grues.

Motores de Grúas.

Крановые Моторы.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

Lift Motors.

Moteurs d'Ascenseurs.

Motores para Ascensores.

Лифтовые Моторы.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELECTROMOTORS, LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.
WILSON-WOLF ENGINEERING CO., LTD.

Motor Converters, see "Converters (Motor)."

Transformateurs en Cascade, voir ce mot.

Transformadores en Cascada, véase esta palabra.

Каскадные Конвертеры, см. это слово.

Motor Starters and Panels, see "Control Gear."

Motors, Petrol, see "Prime Movers."

Moteurs à Essence, voir "Machines Motrices."

Motores de Bencina, véase "Máquinas-Motoras."

Бензиновые Двигатели, см. „Двигатели".

Motors, Tramway and Railway, see " Traction."

Moteurs pour Tramways et Chemins de Fer, voir " Traction."

Motores para Tranvias y Ferrocarriles, véase " Tracción."

Трамвайные и Желѣзнодорожные Моторы, см. „Подвижные Составы".

NOVELTIES, Advertising and other.

NOUVEAUTES pour Réclames, etc.

NOVEDADES para Reclamos, etc.

НОВОСТИ для Рекламныхъ Цѣлей и др.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

PENDANTS, see " Fittings."

LAMPES à SUSPENSION, voir " Garnitures."

LAMPARAS de SUSPENSION, véase " Guarniciones."

ПОДВѢСНЫЯ ЛАМПЫ, см. „Гарнитуры".

PHOTOMETERS.

PHOTOMETRES.

FOTOMETROS.

ФОТОМЕТРЫ.

ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.

PRIME MOVERS.

MACHINES MOTRICES.

MAQUINAS-MOTORAS.

ДВИГАТЕЛИ.

Diesel Engines.

Moteurs Diesel.

Motores Diesel.

Двигатели Дизеля.

BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
HICK, HARGREAVES & CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON, LTD.

Gas Engines.

Moteurs à Gaz.

Motores de Gas.

Газовые Двигатели.

ALLEN, W. H., SON & CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
RICHARDSONS, WESTGARTH & CO., LTD.

Petrol and Oil Engines.

Moteurs à Pétrole et à Essence.

Motores de Bencina y de Aceite.

Бензиновые и Нефтяные Двигатели.

ALLEN, W. H., SON & CO., LTD.
BELLISS & MORCOM, LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.

Reciprocating Steam Engines.

Machines à Vapeur à Piston.

Máquinas de Vapor de Emboló.

Поршневыя Паровыя Машины.

ALLEN, W. H., SON & CO., LTD.
ASHWORTH & PARKER.
BELLISS & MORCOM, LTD.
BROTHERHOOD, PETER, LTD.
BROWETT, LINDLEY & CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
COLE, MARCHENT & MORLEY, LTD.
FRASER & CHALMERS, LTD.
HICK, HARGREAVES & CO., LTD.
HOWDEN, JAMES, & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
SANDYCROFT, LTD.

Steam Turbines.

Turbines à Vapeur.

Turbinas de Vapor.

Паровыя Турбины.

ALLEN, W. H., SON & CO., LTD.
BELLISS & MORCOM, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
FRASER & CHALMERS, LTD.
GREENWOOD & BATLEY, LTD
HOWDEN, JAMES, & CO., LTD.
PARSONS, C. A., & CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WILLANS & ROBINSON, LTD.

Water Turbines.

Turbines Hydrauliques.

Turbinas Hidráulicas.

Водяныя Турбины.

ASHWORTH & PARKER.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FRASER & CHALMERS, LTD.

PUMPS.

POMPES.

BOMBAS.

НАСОСЫ.

Centrifugal Pumps.

Pompes Centrifuges.

Bombas Centrifugas.

Центробѣжные Насосы.

ALLEN, W. H., SON & CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.

BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROTHERHOOD, PETER, LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

Plunger Pumps.
Pompes à Piston.
Bombas de Embolo.
Плунжерные Насосы.

CLARKE, CHAPMAN & CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
FRASER & CHALMERS, LTD.
MIRRLEES WATSON CO., LTD.
PARSONS, C. A., & CO., LTD.
SANDYCROFT, LTD.
WORTHINGTON PUMP CO., LTD.

Rotary Pumps.
Pompes Rotatives.
Bombas Rotativas.
Ротацiонные Насосы.

ALLEN, W. H., SON & CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
MATHER & PLATT, LTD.
MIRRLEES WATSON CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

Sinking Pumps.
Pompes d'Exhaure.
Bombas para Minas.
Рудничные Насосы.

BRITISH ELECTRIC PLANT CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
REES ROTURBO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
WORTHINGTON PUMP CO., LTD.

Turbine Pumps for High Lifts.
Pompes à Turbines Etagées pour H.P.
Bombas de Turbina en Grados para A.P.
Турбо-Насосы для Высокаго Давленiя.

ALLEN, W. H., SON & CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
FRASER & CHALMERS, LTD.
MATHER & PLATT, LTD.
PARSONS, C. A., & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
WILLANS & ROBINSON, LTD.
WORTHINGTON PUMP CO., LTD.

PUSHES, see " Accessories."
BOUTONS, voir " Accessoires."
BOTONES, véase " Accesorios."
ЗВОНКОВЫЯ КНОПКИ, см. ,,Принадлежност.:".

PYROMETERS.
PYROMETRES.
PIROMETROS.
ПИРОМЕТРЫ.

CROMPTON & CO., LTD.
PAUL, ROBERT W.
SIEMENS BROS. & CO., LTD.

RADIATORS, see also " Heating and Cooking."
RADIATEURS, voir aussi " Chauffage et Cuisine."
RADIADORES, véase también " Caldeo y Cocina."
РАДIАТОРЫ, см. также ,,Отопленie Кухонные Приборы".

BERRY, SKINNER & CO.
BRITISH ELECTRIC TRANSFORMER CO., LTD
BRITISH THOMSON-HOUSTON CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

RADIATOR LAMPS, see " Lamps."
LAMPES pour RADIATEURS, voir " Lampes."
LAMPARAS para RADIADORES, véase " Lámparas."
ЛАМПЫ для РАДIАТОРОВЪ, см. Лампы.

REFLECTORS, see " Fittings for Electric Light."
REFLECTEURS, voir " Accessoires pour Lumière Electrique."
REFLECTORES, véase " Accesorios para Luz Eléctrica."
РЕФЛЕКТОРЫ, см. ,,Принадлежности для Электр. Свѣта".

RELAYS, see also " Instruments " and " Control Gear."
RELAIS, voir " Instruments " et " Appareils Contrôleurs."
RELEVADORES, véase " Instrumentos " y " Aparatos de Comprobación."
РЕЛЭ, см. ,,Инструменты" и ,,Контрольные Аппараты".

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
ELLIOTT BROTHERS.
ERSKINE, HEAP & CO., LTD.
EVERETT, EDGCUMBE & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
NALDER BROS. & THOMPSON, LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. & CO., LTD.
SWITCHGEAR & COWANS, LTD

RHEOSTATS, see " Control Gear."
RHEOSTATS, voir " Appareils Contrôleurs."
REOSTATOS, véase " Aparatos de Comprobación."
РЕОСТАТЫ, см. ,,Контрольные Аппараты".

ROLLING MILLS, Electrical Equipment of.
Equipement Electrique de **LAMINOIRS.**
Equipos Eléctricos de **LAMINADORES.**
ВАЛЬЦОВКИ, ихъ Электр. Оборудованіе.

BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
ELECTRIC CONTROL, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
VICKERS, LTD.

ROTARY CONVERTERS, see " Converters, Rotary."
COMMUTATRICES, voir ce mot.
CONVERTIDORES ROTATORIOS, véase esta palabra.
ВРАЩАЮЩІЕСЯ КОНВЕРТЕРЫ (ПРЕОБРАЗОВАТЕЛИ), см. ,,Конвертеры".

SAFETY LAMPS, see " Lamps."
LAMPES de MINEURS, voir " Lampes."
LAMPARAS de MINEROS, véase " Lámparas."
БЕЗОПАСНЫЯ ЛАМПЫ, см. Лампы.

SEARCHLIGHT PROJECTORS.
PROJECTEURS.
PROYECTORES.
ПРОЖЕКТОРЫ.

BRITISH THOMSON-HOUSTON CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
PARSONS, C. A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

SHADES, see " Fittings " and " Glassware."
ABAT-JOUR, voir " Accessoires " et " Verreries."
PANTALLAS, véase " Accesorios " y " Cristalería."
АБАЖУРЫ, см. ,,Принадлежности" и ,,Стеклянная Посуда".

SHIP INSTALLATIONS, Electric.
INSTALLATIONS Electriques pour **NAVIRES.**
INSTALACIONES Eléctricas para **BUQUES.**
СУДОВЫЯ Электрическія ОБОРУДОВАНІЯ.

ALLEN, W. H., SON & CO., LTD.
BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
ELLIOTT BROTHERS.
GENERAL ELECTRIC CO., LTD.
HOWDEN, JAMES, & CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD
MAWDSLEY'S, LTD.
PARSONS, C. A., & CO
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.

Ships' Telegraph.
Télégraphes de Navires.
Télégrafos para Buques.
Судовые Телеграфы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
ELLIOTT BROTHERS.
EVERSHED & VIGNOLES, LTD.
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. & CO., LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.

Shipyard Cranes and Winches.
Grues et Treuils pour Chantiers de Construction Navale.
Grúas y Tornos para Astilleros.
Краны и Лебедки для Верфей.

BOOTHROYD, H. T., LTD.
BRITISH ELECTRIC PLANT CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CLARKE, CHAPMAN & CO., LTD.
CROMPTON & CO., LTD.
FRASER & CHALMERS, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUNDERLAND FORGE & ENGINEERING CO., LTD.
VICKERS, LTD.

SIGNALLING for RAILWAYS, Electrically operated.
SIGNALISATION Electriques pour **CHEMINS de FER.**
SEÑALES Eléctricos para **FERROCARRILES.**
ЖЕЛѢЗНОДОРОЖНАЯ СИГНАЛИЗАЦІЯ, Электр.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD

SIGNALS, Fire Alarms, etc.

SIGNAUX, Avertisseurs d'Incendie, etc.

SEÑALES, Alarmas de Incendio, etc.

СИГНАЛЫ, Пожарные и др.

GENERAL ELECTRIC CO., LTD
SIEMENS BROS. & CO., LTD.

SIGNS, Electrically Illuminated.

RECLAMES Lumineuses Electriques.

RECLAMOS Luminosos Eléctricos.

ВЫВѢСКИ Электрическія.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD
GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.
VENNER & CO.

STARTERS and STARTING PANELS, see "Control Gear."

DEMARREURS et TABLEAUX de DEMARRAGE, voir "Appareils Contrôleurs."

APARATOS y CUADROS de ARRANQUE, véase "Aparatos de Comprobación."

ПУСКОВЫЕ РЕОСТАТЫ и ДОСКИ, см. „Контрольные Аппараты".

STEAM ENGINES and STEAM TURBINES, see "Prime Movers."

MACHINES et TURBINES à VAPEUR, voir "Machines Motrices."

MAQUINAS y TURBINAS de VAPOR, véase "Máquinas-Motoras."

ПАРОВЫЯ МАШИНЫ и ТУРБИНЫ, см. „Двигатели".

STORAGE, Electrical, see "Accumulators."

ACCUMULAGE d'Electricité, voir "Accumulateurs."

ALMACENAJE de Electricidad, véase "Acumuladores."

АККУМУЛЯЦІЯ Электричества, см. „Аккумуляторы".

SWITCHES, see "Accessories" and "Switchgear."

INTERRUPTEURS, voir "Accessoires" et "Appareils de Distribution."

INTERRUPTORES, véase "Accesorios" y "Aparatos de Distribución."

ВЫКЛЮЧАТЕЛИ, см. „Принадлежности" и „Распредѣлительныя Устройства".

SWITCHGEAR, SWITCHES and SWITCHBOARDS for Mining, Industrial and General Power Purposes.

APPAREILS de DISTRIBUTION, INTERRUPTEURS et TABLEAUX de DISTRIBUTION pour Mines, Usines et Centrales.

APARATOS de DISTRIBUCION, INTERRUPTORES y CUADROS de DISTRIBUCION para Minas, Fábricas y Centrales.

РАСПРЕДѢЛИТЕЛЬНЫЯ УСТРОЙСТВА и ДОСКИ для Рудниковъ, Промышленныхъ и общихъ Цѣлей.

BERRY, SKINNER & CO.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELECTRIC CONTROL, LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE, LTD.
ERSKINE, HEAP & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
MORRIS & LISTER, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
VENNER & CO. (Time Switches).
WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

Accumulator Switches (Battery Regulating Switches).

Réducteurs d'Accumulateurs (Réducteurs de Batterie).

Reductores de Acumuladores (Reductores de Batería).

Аккумуляторные Коммутаторы (Элементные Коммутаторы).

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE.
ERSKINE, HEAP & CO., LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MAVOR & COULSON, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.

WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

Circuit Breakers.
Interrupteurs à Levier.
Interruptores de Palanca.
Рычажные Выключатели.

BERRY, SKINNER & CO.
BRAY, MARKHAM & REISS, LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BROOK, HIRST & CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRICAL APPARATUS CO., LTD.
ELLISON, GEORGE, LTD.
ERSKINE, HEAP & CO. LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
MORRIS & LISTER, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
RECORD ELECTRICAL CO., LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WHIPP & BOURNE.

Knife Switches.
Interrupteurs à Couteau.
Interruptores de Cuchillo.
Рубильники.

BERRY, SKINNER & CO.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
CROMPTON & CO., LTD.
DICK, KERR & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.
ELLISON, GEORGE.
ERSKINE, HEAP & CO., LTD.
FERRANTI, LTD.
GENERAL ELECTRIC CO., LTD.
IGRANIC ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
REYROLLE, A., & CO., LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
SWITCHGEAR & COWANS, LTD.
WESTMINSTER ENGINEERING CO., LTD.
WHIPP & BOURNE.

TELEGRAPH APPARATUS.
APPAREILS TELEGRAPHIQUES.
APARATOS TELEGRAFICOS.
ТЕЛЕГРАФНЫЕ АППАРАТЫ.

ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
GENERAL ELECTRIC CO., LTD.
PARK ROYAL ENGINEERING WORKS, LTD.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. & CO., LTD.

Telegraphy, Wireless, see "Wireless Telegraphy."
Télégraphie sans Fil, voir "Radio-Télégraphie."
Telegrafia sin Alambres, véase "Radio-Telegrafia."
Безпроволочный Телеграфъ, см. ,,Радіо-Телегр. Аппараты".

TELEPHONES.
TELEPHONES.
TELEFONOS.
ТЕЛЕФОНЫ.

GENERAL ELECTRIC CO., LTD.
SIEMENS BROS. & CO., LTD.

Automatic Telephones.
Téléphones Automatiques.
Teléfonos Automáticos.
Автоматическіе Телефоны.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. & CO., LTD.

TELEPHONE SWITCHBOARDS.
TABLEAU COMMUTATEURS pour TELEPHONES.
CUADROS CONMUTADORES para TELEFONOS.
ТЕЛЕФОННЫЕ КОММУТАТОРЫ.

EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
SIEMENS BROS. & CO., LTD.

TERMINALS, see "Accessories."
BORNES, voir "Accessoires."
BORNAS, véase "Accesorios."
ЗАЖИМЫ, см. ,,Принадлежности".

TESTING SETS, see also "Instruments."
APPAREILS de LABORATOIRE, voir aussi "Instruments."
APARATOS de LABORATORIO, véase también "Instrumentos."
ПРИБОРЫ для ИСПЫТАНІЯ, см. также ,,Инструменты".

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
CROMPTON & CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
ELLIOTT BROTHERS.
EVERETT, EDGCUMBE & CO., LTD.
EVERSHED & VIGNOLES, LTD.
GENERAL ELECTRIC CO., LTD.
JOHNSON & PHILLIPS, LTD.
NALDER BROS. & THOMPSON, LTD.
PAUL, ROBERT W.
RECORD ELECTRICAL CO., LTD.
SIEMENS BROS. & CO., LTD.

TEXTILE MOTORS and EQUIPMENT.

MOTEURS et ACCESSOIRES pour l'INDUSTRIE TEXTILE.

MOTORES y ACCESORIOS para la INDUSTRIA TEXTIL.

МОТОРЫ и ОБОРУДОВАНІЯ въ ТЕКСТИЛЬНОЙ ПРОМЫШЛЕННОСТИ.

BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CROMPTON & CO., LTD.
GENERAL ELECTRIC CO., LTD.
GREENWOOD & BATLEY, LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD
MATHER & PLATT, LTD.
MAVOR & COULSON, LTD.
MAWDSLEY'S, LTD.
PEEBLES, BRUCE, & CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.
WILSON-WOLF ENGINEERING CO., LTD.

THEATRE LIGHTING.

ECLAIRAGE de THEATRES.

ALUMBRADO de TEATROS.

ОСВѢЩЕНІЕ ТЕАТРОВЪ.

BRITISH THOMSON-HOUSTON CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
SIEMENS BROTHERS DYNAMO WORKS, LTD.
SUN ELECTRICAL CO., LTD.

TRACTION APPLIANCES.

MATERIEL de TRACTION.

MATERIAL de TRACCION.

ПОДВИЖНЫЕ СОСТАВЫ.

Bonds.
Eclisses.
Juntas.
Стыки.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
GLOVER, W. T., & CO., LTD.

Brakes.
Freins.
Frenos.
Тормаза.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
COLE, MARCHENT & MORLEY, LTD.

Car Bodies.
Carrosserie.
Carroceria.
Вагонные Кузовы.

BRUSH ELECTRICAL ENGINEERING CO., LTD.

Gears.
Engrenages.
Engranajes.
Приводы.

BRITISH THOMSON-HOUSTON CO., LTD
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
VICKERS, LTD.

Locomotives.
Locomotives.
Locomotoras.
Локомотивы.

BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.

Motors.
Moteurs.
Motores.
Моторы.

BOOTHROYD, H. T., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
DICK, KERR & CO., LTD.
PEEBLES, BRUCE, & CO., LTD.
REES ROTURBO MANUFACTURING CO., LTD.
RHODES MOTORS, LTD.
SIEMENS BROS. DYNAMO WORKS LTD.

Controllers, see "Control Gear."
Contrôleurs, voir "Appareils Contrôleurs."
Controleres, véase "Aparatos de Comprobación."
Контролеры, см. „Контрольные Аппараты".

Line Insulators, see "Insulators."
Isolateurs pour Lignes Aériennes, voir "Isolateurs."
Aisladores para Lineas Aéreas, véase "Aisladores."
Изоляторы для Трамвайныхъ Воздушныхъ Проводокъ, см. „Изоляторы".

Overhead Lines, see "Transmission."
Lignes Aériennes, voir "Transport d'Energie."
Lineas Aéreas, véase "Transmisión de Energía."
Воздушныя Проводки, см. „Передача Силы".

TRANSFORMERS for Power and Lighting.

TRANSFORMATEURS pour Force Motrice et Eclairage.

TRANSFORMADORES para Fuerza Motriz y Alumbrado.

ТРАНСФОРМАТОРЫ для Силы и Освѣщенія.

BRITISH ELECTRIC TRANSFORMER CO., LTD.
BRITISH THOMSON-HOUSTON CO., LTD.
BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO., LTD.
BRUSH ELECTRICAL ENGINEERING CO., LTD.
FERRANTI, LTD.
JOHNSON & PHILLIPS, LTD.
SIEMENS BROS. DYNAMO WORKS, LTD.

Transformers for Instruments, see "Instruments."
Transformateurs pour Instruments, voir "Instruments."
Transformadores para Instrumentos, véase "Instrumentos."
Трансформаторы для Инструментовъ, см. „Инструменты".

TRANSMISSION LINES.

LIGNES pour le TRANSPORT d'ENERGIE.
LINEAS para la TRANSMISION de ENERGIA.
ЛИНІИ для ПЕРЕДАЧИ СИЛЫ.

Poles.
Poteaux.
Postes.
Столбы.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. & CO., LTD.

Overhead Lines, Aluminium.
Lignes Aériennes en Aluminium.
Lineas Aéreas de Aluminio.
Алюминіевыя Воздушныя Линіи.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SANDYCROFT, LTD.

Overhead Lines, Copper.
Lignes Aériennes en Cuivre.
Lineas Aéreas de Cobre.
Мѣдныя Воздушныя Линіи.

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
GLOVER, W. T., & CO., LTD.
JOHNSON & PHILLIPS, LTD.
SANDYCROFT, LTD.
SIEMENS BROS. & CO., LTD.

Insulators for Transmission Lines, see "Insulators."
Isolateurs pour Lignes de Transport d'Energie, voir "Isolateurs."
Aisladores para lineas de Transporte de Energia, véase "Aisladores."
Изоляторы для Воздушныхъ Линій, см. „Изоляторы".

TUBING, see "Conduit."

TUBES, voir "Tubes Isolants."
TUBOS, véase "Tubos Aisladores."
ТРУБКИ, см. „Изоляціонныя Трубки".

TURBINES, Steam and Water, see "Prime Movers."

TURBINES à Vapeur et Hydrauliques, voir "Machine Motrices."
TURBINAS de Vapor y Hidráulicas, véase "Máquinas-Motoras."
ТУРБИНЫ, Паровыя и Водяныя, см. „Двигатели".

VENTILATING FANS, see "Fans."

VENTILATEURS EXTRACTEURS, voir "Ventilateurs."
VENTILADORES EXTRACTORES, véase "Ventiladores."
ВЫТЯЖНЫЕ ВЕНТИЛЯТОРЫ, см. „Вентиляторы".

WATER COOLING TOWERS.

TOURS REFRIGERANTES A EAU.
TORRES REFRIGERANTES POR AGUA.
ГРАДИРНИ.

PREMIER COOLER & ENGINEERING CO., LTD.
RICHARDSONS, WESTGARTH & CO., LTD.
WORTHINGTON PUMP CO., LTD.

WELDING, Electric, Appliances.

Appareils de **SOUDURE** Electrique.
Aparatos de **SOLDADURA** Eléctrica.
Аппараты для Электр. **СВАРКИ.**

CROMPTON & CO., LTD.
LANCASHIRE DYNAMO & MOTOR CO., LTD.
PHŒNIX DYNAMO MANUFACTURING CO., LTD.
WESTMINSTER ENGINEERING CO., LTD.

WINCHES, see "Arc Lamps" and "Ship Installations."

TREUILS de LEVAGE, voir "Lampes à Arc" et "Installations pour Navires."
TORNOS de ELEVACION, véase "Lámparas de Arco" y "Instalaciones para Buques."
ЛЕБЕДКИ, см. „Дуговыя Лампы" и „Судовыя Оборудованія".

WIRELESS TELEGRAPHY APPLIANCES.

APPAREILS RADIO-TELEGRAPHIQUES.
APARATOS RADIO-TELEGRAFICOS.
РАДІО-ТЕЛЕГРАФНЫЕ АППАРАТЫ.

LANCASHIRE DYNAMO & MOTOR CO., LTD.
SIEMENS BROS. & CO., LTD.

WIRES, see also "Cables."

FILS, voir aussi "Cables."
ALAMBRES, véase también "Cables."
ПРОВОДА, см. также „Кабели".

CALLENDER'S CABLE & CONSTRUCTION CO., LTD.
EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.
GENERAL ELECTRIC CO., LTD.
GLOVER, W. T., & CO., LTD.
HENLEY'S, W. T., TELEGRAPH WORKS, LTD.
JOHNSON & PHILLIPS, LTD.
LIVERPOOL ELECTRIC CABLE CO., LTD.
PIRELLI, LTD.
SIEMENS BROS. & CO., LTD.

INDEX FRANCAIS.

avec la traduction en anglais des en-tête sous lesquels est arrangé alphabétiquement l'Index Général en quatre langues, voir pages 241—261.

Index Francais.

Français.	Anglais.
Globes de Lampes à Arc....	Arc Lamp Globes
Grues	Cranes
Grues pour Chantiers de Construction Navale	Shipyard Cranes
Sous "Ship Installations."	
Halâge (Appareils de)......	Haulage Gear
Sous " Mines, Equipments for "	
Holophanes (Verreries)	Holophane Ware
Sous "Glassware."	
Horloges Electriques.......	Clocks, Electrically driven
Houillères	Collieries
Sous "Mines, Equipments for "	
Indicateurs	Indicators
Sous " Accessories."	
Induction (Bobines d')	Induction Coils
Installations pour Navires..	Ship Installations
Instruments	Instruments
Instruments de Mesure......	Instruments, Indicating
Instruments Enregistreurs ..	Recording Instruments
Interrupteurs	Switches
Interrupteurs à Boule......	Tumbler Switches
Interrupteurs à Levier......	Circuit Breakers
Interrupteurs à Couteau....	Knife Switches
Isolateurs	Insulators
Isolateurs en Porcelaine....	Porcelain Insulators
Isolateurs de Suspension....	Suspension Insulators
Isolateurs de Tramway.....	Tramway Insulators
Joints Extensibles..........	Expansion Joints
Sous "Cables."	
Laboratoire (Appareils de)..	Testing Sets
Laminoirs, etc.	Rolling Mills, Equipment for
Lampes	Lamps
Lampes à Incandescence....	Incandescent Lamps
Lampes à Main............	Hand Lamps
Lampes Portatives..........	Standard Lamps
Lampes pour Radiateurs....	Radiator Lamps
Lampes à Suspension.......	Pendants
Lanternes.................	Lanterns
Lignes Aériennes...........	Overhead Lines
Lignes pour Transport d'Energie	Transmission Lines
Locomotives	Locomotives
Sous "Traction."	
Lustres	Electroliers
Sous " Fittings."	
Machines	Engines
Sous "Prime Movers."	
Machines d'Extraction......	Winding Engines
Sous "Mines, Equipment for."	
Machines Motrices.........	Prime Movers
Machines à Vapeur à Piston	Reciprocating Steam Engines
Sous "Prime Movers."	
Magnétos	Magnetos
Matériel pour Eclairage Public	Street Fittings
Sous "Fittings."	
Matériel de Traction........	Traction Appliances
Matières Isolantes..........	Insulating Material

Français.	Anglais.
Mica	Mica
Mines, etc.	Mines, Equipments for
Monte-Charges	Hoists
Sous "Motors."	
Moteurs, Diesel	Diesel Engines
Sous "Prime Movers."	
Moteurs d'Ascenseurs......	Lift Motors
Moteurs pour Chemins de Fer	Motors, Railway
Moteurs pour C.C. et C.A...	Motors for A.C. and D.C.
Moteurs Etanches au Gaz..	Flameproof Motors
Sous "Mines, Equipments for"	
Moteurs à Essence.........	Oil Engines
Sous "Prime Movers."	
Moteurs à Gaz............	Gas Engines
Sous "Prime Movers."	
Moteurs-Générateurs	Motor-Generators
Moteurs de Grues..........	Crane Motors
Moteurs pour l'Industrie Textile	Textile Motors
Moteurs à Petrole..........	Petrol Engines
Sous "Prime Movers."	
Moteurs pour Tramway	Motors, Tramway
Moulures pour Fils.........	Casing and Capping
Sous " Accessories."	
Nettoyeuses au Vide........	Vacuum Cleaners
Sous "Domestic Appliances."	
Nouveautés pour Réclames..	Novelties, Advertising
Parafoudres	Lightning Arresters
Photomètres	Photometers
Piles d'Allumage...........	Ignition Cells
Sous " Batteries."	
Piles Hydroélectriques......	Wet Cells
Sous " Batteries."	
Piles Sèches...............	Dry Cells
Sous "Batteries."	
Pompes	Pumps
Pompes Centrifuges........	Pumps, Centrifugal
Pompes d'Exhaure pour Mines	Sinking Pumps
Pompes à Piston..........	Plunger Pumps
Pompes Rotatives..........	Rotary Pumps
Pompes à Turbines.........	Turbine Pumps
Poteaux de Lampes à Arc..	Arc Lamp Standards
Sous " Arc Lamps.'	
Poteaux de Lignes Aériennes	Poles for Overhead Lines
Sous "Transmission Lines."	
Prises de Courant pour Fiches...................	Plugs and Sockets
Sous " Accessories."	
Projecteurs	Searchlight Projectors
Pyromètres	Pyrometers
Radiateurs	Radiators
Radiateurs à Eléments de Résistance	Radiators, Non-luminous
Radiomètres pour Rayons X.	X-Ray Outfits
Radio-Télégraphie	Wireless Telegraphy
Réclames Electriques	Signs, Electrically Illuminated
Réducteurs d'Accumulateurs	Accumulator Switches
Sous " Switchgear."	
Réflecteurs................	Reflectors
Sous " Fittings."	

ÍNDICE ESPAÑOL

con la traducción en inglés de los títulos, bajo les cuales se ha arreglado alfabéticamente el Indice General en cuatro idiomas, véase páginas 241—261.

Índice Español.

РУССКІЙ УКАЗАТЕЛЬ

съ переводомъ на англійскій языкъ, по алфавиту котораго составленъ Общій Указатель на четырехъ языкахъ, см. стран. 153—173.

Русскій Указатель.

По-Русски.	По-Англійски.
Конденсаторы, Электрическіе	**Condensers, Electrical**
Консольные Вентиляторы	**Bracket Fans**
Контачныя Штепселя и Коробки	**Plugs and Sockets**
Подъ "Accessories."	
Контрольные Аппараты	**Control Gear**
Контролеры для Крановыхъ Моторовъ	**Controllers for Crane Motors**
Подъ "Control Gear."	
Контролеры для Трамвайныхъ Моторовъ	**Controllers for Traction Work**
Подъ "Control Gear."	
Коробки (Отвѣтв.)	**Junction Boxes**
Коробки для Штепселей	**Sockets for Plugs**
Подъ "Accessories."	
Котельная Арматура	**Boiler Equipment**
Котлы	**Boilers**
Краны и Лебедки для Верфей	**Shipyard Cranes and Winches**
Подъ "Ship Installations."	
Крановые Моторы	**Crane Motors**
Кронштейны	**Brackets**
Подъ "Fittings."	
Лампы	**Lamps**
Лампы Накаливанія	**Incandescent Lamps**
Лампы для Радіаторовъ	**Radiator Lamps**
Лебедки для Дуговыхъ Лампъ	**Arc Lamp Winches**
Подъ "Arc Lamps."	
Легко-Плавкія Вставки	**Fuses**
Лифты (Электрическіе)	**Lifts, Electric**
Лифтовые Моторы	**Lift Motors**
Локомотивы	**Locomotives**
Подъ "Traction Appliances."	
Люстры	**Electroliers**
Подъ "Fittings."	
Магнеты	**Magnets**
Магнета	**Magnetos**
Магнитные Тормаза	**Brakes (Magnetic)**
Матеріалъ для Уличнаго Освѣщенія	**Street Fittings**
Подъ "Fittings."	
Мокрые Элементы	**Wet Cells**
Подъ "Batteries."	
Моторы Дызелъ	**Diesel Motors**
Подъ "Prime Movers."	
Моторы въ Текстильной Промышлен.	**Textile Motors**
Моторы для Перем. и Пост. Тока	**Motors for A.C. and D.C.**
Нагрѣвательные Приборы	**Heating Appliances**
Насосы	**Pumps**
Настольные Вентиляторы	**Table Fans**
Подъ "Prime Movers."	
Новости для Рекламныхъ Цѣлей	**Novelties, Advertising**
Освѣщеніе Театровъ	**Theatre Lighting**
Отвѣтвительныя Коробки	**Junction Boxes**
Паровыя Турбины	**Steam Turbines**
Патроны	**Lampholders**
Подъ "Accessories."	
Переносные Сверлильные Станки	**Portable Drilling Machines**
Переносныя Лампы	**Standard Lamps**
Подъ "Fittings."	
Пирометры	**Pyrometers**
Плунжерные Насосы	**Pumps, Plunger**
Повысители Напряженія	**Boosters**
Подвижные Составы	**Traction Appliances**
Подводные Кабели	**Submarine Cables**
Подъ "Cables."	
Подвѣсные Изоляторы	**Suspension Insulators**
Подъ "Insulators."	
Подвѣсныя Лампы	**Pendants**
Подъ "Fittings."	
Подъемники (Электр.)	**Hoists, Electric**
Пожарные Сигналы	**Fire Alarms**
Подъ "Signals."	
Поршневыя Паровыя Машины	**Reciprocating Steam Engines**
Подъ "Prime Movers."	
Постоянные Магниты	**Magnets, Permanent**
Потолочные Вентиляторы	**Ceiling Fans**
Подъ "Fans."	
Потолочныя Гарнитуры	**Ceiling Fittings**
Подъ "Fittings."	
Потолочныя Розетки	**Ceiling Roses**
Подъ "Accessories."	
Предохранители	**Cut-Outs**
Преобразователи	**Rotary Converters**
Прессованные Картоны	**Press Spahn**
Подъ "Insulating Material."	
Приборы для Испытанія	**Testing Sets**
Приборы для Рентгеновскихъ Лучей	**X-Ray Outfits**
Принадлежности	**Accessories**
Принадлежности для Электр. Свѣта	**Fittings for Electric Light**
Провода	**Wires**
Проводки для Передачи Силы	**Transmission Lines**
Проводовыя Рейки	**Casing and Capping**
Подъ "Accessories."	
Противовѣсы	**Counterweights**
Подъ "Fittings."	
Пусковые Аппараты и Доски для Моторовъ	**Starters and Starting Panel**
Пылесосы	**Vacuum Cleaners**
Подъ "Domestic Appliances."	
Радіаторы	**Radiators**
Радіаторы (Безсвѣтные)	**Radiators, Non-Luminous**
Радіо-Телеграфные Аппараты	**Wireless Telegraphy Appliances**
Распредѣлительныя Доски	**Distribution Boards**
Распредѣлительныя Устройства	**Switchgear**
Растяжимыя Соединенія	**Expansion Joints**
Подъ "Cables."	
Рейки для Проводовъ	**Casing and Capping**
Подъ "Accessories."	
Релэ	**Relays**
Реостаты	**Rheostats**

INDEX TO COMPANIES IN CLASSIFIED DIRECTORY

NAME.	Head Offices or Works.	Telegraphic Address	Codes Used
*ALLEN WEST & CO., LTD.	Lewes Road, Brighton	Control, Brighton	5th Edition, A.B.C.
ALLEN, W. H., SON & CO., LTD.	Queen's Engineering Works, Bedford	Pump, Bedford	A.B.C. 5th Edition, A1 Engineering, Broomhall Imperial Atom, Western Union and Private.
ALLEY & MACLELLAN, LTD.	Sentinel Works, Polmadie, Glasgow	Alley, Glasgow	A.B.C. 5th Edition, Engineering Telegraph, Western Union.
*ARON ELECTRICITY METER, LTD.	80A, Salusbury Road, Kilburn, London, N.W.	Arronzar, London	A B C 4th and 5th Editions.
ASHWORTH & PARKER	Bury, Lancs	Kinetic	Western Union, A.B.C. 5th Edition.
*BELLISS & MORCOM, LTD.	Ledsam Street Works, Birmingham	Belliss, Birmingham	A.B.C. 5th Edition, Engineering 2nd Edition, Western Union (Universal Edition), Lieber's.
*BERRY, SKINNER & CO.	78, Upper Thames Street, London, E.C.	Ptolemaist	A B C Code 4th and 5th Editions
" " "	Suffolk Works, Oozells Street, Birmingham	"	Western Union, Universal Edition.
*BOOTHROYD H. T., LTD	Bootle, Liverpool	Commutator, Liverpool.	———————
BRAY, MARKHAM & REISS, LTD.	Blackhorse Lane, Walthamstow, N.E.	Bramaria, Walthill, London	———————
*BRITISH ELECTRIC PLANT CO., LTD	78, St. Vincent Street, Glasgow	Bepco, Glasgow	A.B.C. 5th Edition.
*BRITISH ELECTRIC TRANSFORMER CO., LTD	Hayes, Middlesex, and 48, Oxford Street, London, W.	Transfundo, Hayes, Middlesex	A B C. 5th Edition, Western Union, Engineering, 2nd Edition.
*BRITISH THOMSON-HOUSTON CO., LTD.	Rugby England	Asteroidal Rugby; Solutrix, London	Lieber, A.B.C. and Western Union.
" " " "	Mazda House, 77, Upper Thames Street, E.C.	Mazdalux, Cannon, London	Lieber's A B C
*BRITISH WESTINGHOUSE ELECTRIC & M'F'G. CO., LTD.	Trafford Park, Manchester	Westinghouse, Manchester	A.B.C. 5th Edition, Western Union; Lieber's.
*BROOK, HIRST & CO., LTD.	Northgate Electrical Works, Chester	Switches, Chester	A.B.C. 5th Edition.
BROTHERHOOD, PETER, LTD.	Peterborough	Brotherhood, Peterborough. Brotherhood, Parl, London.	A.B.C. 5th Edition.
*BROWETT, LINDLEY & CO., LTD.	Patricroft, Manchester	Sandon, Patricroft	Lieber's, A.B.C. 5th Edition, Engineering.
*BRUSH ELECTRICAL ENGINEERING CO., LTD.	Falcon Works, Loughborough, Leicestershire	Falcon, Loughborough.	A B C. 5th Edition, A1, Western Union, Engineering.
" " " "	LONDON OFFICE:—1, Kingsway, London, W.C.	Magneto, London.	" " "
*CALLENDER'S CABLE & CONSTRUCTION CO., LTD.	Hamilton House, Victoria Embankment, London, E.C.	Callender, Fleet, London	———————
CHAMBERLAIN & HOOKHAM, LTD.	Solar Works, Birmingham	Solar, Birmingham	ABC. 5th Edition, Western Union
*CLARKE, CHAPMAN & CO., LTD.	Gateshead-on-Tyne	Cyclops, Gateshead	A.B.C. 4th and 5th Editions, A1, Engineering 1st and 2nd Editions, Lieber's, Broomhall's, Moreing and Neil's, Watkins, Western Union and Private.
*COLE, MARCHENT & MORLEY, LTD.	Wakefield Road, Bradford, England	Cole, Bradford	A1, A.B.C. 5th Edition, Engineering 1st and 2nd Editions, Western Union, Lieber's.
CREDENDA CONDUITS CO., LTD.	Chester Street, Aston, Birmingham	Credenda, Birmingham	———————
*CROMPTON & CO., LTD.	Salisbury House, London Wall, E.C.	Crompton, Ave, London	Bentley, A.B.C. 5th Edition, Lieber's.
DAY, ST. JOHN, (PATENTS), LTD.	Bank Mills Morton Street, Oldham	Day, 305 Oldham	A.B.C. 5th Edition.
*DICK, KERR & CO., LTD.	Abchurch Yard, Cannon Street, E.C.	Dicker, London	Bentley, Western Union, Lieber's A.B.C. 5th Edition
D-P. BATTERY CO., LTD.	Lumford Mills, Bakewell, Derbyshire, and 11, Victoria St., Westminster, S.W.	Battery, Bakewell; Cumulose, London.	A.B.C. 5th Edition, New Business, Private.
*EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD.	Ponders End Middlesex	Ediswan, Ponders End.	———————
ELECTRICAL APPARATUS CO., LTD.	Vauxhall Works, South Lambeth Road, London, S.W.	Elapratus, London	A.B.C. 5th Edition
*ELECTRICAL ENGINEERING AND EQUIPMENT CO., LTD.	Bank Buildings, 109-11, New Oxford Street, London, W.C.	Thermotype, Westcent, London	A.B.C. 5th Edition.
*ELECTRIC CONTROL LTD.	177, Reid Street, Glasgow, and	Control, Glasgow	———————
	Queen Anne's Chambers, Westminster, S.W.	Autoswitch, Vic, London	A.B.C. 5th Edition.
*ELECTRIC & ORDNANCE ACCESSORIES CO., LTD.	Cheston Road, Aston, Birmingham	E.O.A. Birmingham	A B.C. 5th Edition.
*ELECTROMOTORS, LTD.	Openshaw, Manchester	Magnet, Manchester	A B.C. 5th Edition.

NAME.	Head Offices or Works.	Telegraphic Address.	Codes Used.
*ELLIOTT BROTHERS	1, Central Buildings, Westminster, S.W.	Elliottize, London	A B C. 5th Edition.
ELLISON, GEORGE	Victoria Works, Warstone Lane, Birmingham	Induction, Birmingham	Western Union, Lieber's and Engineering.
*ERSKINE, HEAP & CO., LTD.	Lancashire Switchgear Works, Broughton, Manchester	Electron	————————
*EVERETT, EDGCUMBE & CO., LTD.	117, Victoria Street, London, S W.	Everectus Sowest, Ldn	A.B.C. 5th Edition
" " " "	FACTORY:—Collindale Works, Hendon, N.W.	Evergendos Hyde, Ldn.	————————
*EVERSHED & VIGNOLES LTD.	Acton Lane Works, Chiswick, London, W.	Dorothea, London	A.B C. 5th Edition, Western Union (Universal Edition), Eng. 2nd Ed.
*FERRANTI, LTD.	Hollinwood, Lancashire	Ferranti, Hollinwood; Cables — Ferranti, London	A.B.C. 4th and 5th Editions, A1, Cole, Engineering, Lieber's, Western Union.
" "	WORKS:—Hollinwood, near Manchester	————————	" " "
*FRASER & CHALMERS, LTD.	Erith, Kent	Vanner, Erith	A.B.C. 4th and 5th Editions, Moreing and Neal, Broomhalls, Imperial, Western Union.
*GENERAL ELECTRIC CO. LTD.	67, Queen Victoria Street, London, E C.	Electricity Cables, Polyphase	A.B.C Lieber's, Western Union.
GLOVER, W. T., & CO., LTD.	Trafford Park, Manchester	Cables, Manchester	A.B.C. 5th Edition, Lieber's, Western Union and Private Code.
*GREENWOOD & BATLEY, LTD	Albion Works, Armley Road, Leeds	Greenwood, Leeds	A.B.C. 4th and 5th Editions, Lieber's, Engineering 1st and 2nd Editions, A1 Western Union and Bentley's.
*HENLEY'S, W. T., TELEGRAPH WORKS, LTD	Blomfield Street, London, E C.	Inland, Henletel Ave, London; Cables—Henleys, London	Western Union, A.B.C., 5th Edition Lieber's and Private.
*HICK HARGREAVES & CO., LTD	Soho Iron Works, Bolton	Hick, Bolton	A.B.C. 5th Edition, A1 (1888), Western Union, Lieber's Standard.
*HOWDEN, JAMES & CO., LTD.	195, Scotland Street, Glasgow	Howden, Glasgow	A B.C. 5th Edition, Western Union.
*IGRANIC ELECTRIC CO., LTD.	147, Queen Victoria Street, London, E.C.	Igranic	Lieber's and Private.
" "	WORK:—Bedford, England	————————	————————
*JANDUS ARC LAMP & ELECTRIC CO., LTD.	Hartham Road, Holloway, London, N.	Jandunus, Holway, London	A.B.C. 5th Edition.
*JOHNSON & PHILLIPS, LTD.	Victoria Works, Charlton, London, S.E.	Juno Charlton, Kent	A.B.C., 5th Edition, A1, 5th Edition Engineering, Lieber's, Western Union.
*LANCASHIRE DYNAMO & MOTOR CO., LTD.	Trafford Park, Manchester	Ironclad, Manchester	A.B.C. 5th Edition, Western Union Engineering, Cole's.
LIVERPOOL ELECTRIC CABLE CO., LTD.	Linacre Lane, Bootle, Liverpool	Concentric, Liverpool	A.B.C. 5th Edition.
LUCY & CO., W., LTD.	Eagle Ironworks, Oxford	Lucy Oxford	————————
*LUNDBERG, A. P., & SONS	477-489, Liverpool Road, London, N	Lundberg, London	A.B C 5th Edition.
*MATHER & PLATT, LTD	Park Works, Newton Heath, Manchester	Mather or Sprinkler, Manchester	Western Union, Universal Edition, Lieber's, A B.C. 4th and 5th Editions, A1, M. & P. Private.
*MAVOR & COULSON, LTD.	47, Broad Street, Mile End, Glasgow	Prodigious, Glasgow	A.B.C. 5th Edition, Engineering 2nd Edition, Bentley's.
*MAWDSLEY'S, LTD.	Zone Works, Dursley, Glos.	Zone, Dursley	A.B.C. 5th Edition.
*MIRRLEES WATSON CO., LTD.	45, Scotland Street, Glasgow, and 122, Cannon Street, London, E.C.	Mirrlees, Glasgow; Mirrlees, Cannon, London	Western Union, Lieber's, Engineering, A.B.C. and A1.
*MORGAN CRUCIBLE CO., LTD	Battersea Works, London, S.W.	Crucible, Battsquare, London (two words chargeable)	A.B.C. 4th and 5th Editions A1 Lieber's and Western Union (Universal Edition).
MORRIS & LISTER, LTD.	Carlton Works, Lockhurst Lane, Coventry	Carlton, Coventry	————————
*NALDER BROS. & THOMPSON, LTD.	97a, Dalston Lane, London, N.E.	Occlude, Kinland, London	Western Union.
*OSRAM-ROBERTSON LAMP WORKS LTD	Brook Green, Hammersmith, London, W.	Electricity London. Cables—Polyphase	A.B.C., Lieber's, Western Union and Private.
*PARK ROYAL ENGINEERING WORKS, LTD.	Cumberland Avenue, Willesden, London, N W.	Isobar, Harles, London.	A.B.C. 5th Edition.
*PARSONS, C. A., & CO., LTD.	Heaton Works, Newcastle-on-Tyne	Turbo, Newcastle-on Tyne	A1, A.B C., Western Union.
" " " "	LONDON OFFICE:—8, Victoria Street, London, S W.	Silently Vic, London	" " "

NAME.	Head Offices and Works.	Telegraphic Address.	Codes Used.
*PAUL, ROBERT W.	Newton Avenue Works, New Southgate, N. and 1, East 42nd Street, New York U.S.A.	Unipivot, London	————
*PEEBLES, BRUCE, & CO., LTD.	Edinburgh	Peebles, Edinburgh	Western Union, A.B.C., 5th Edition. New Business and Private
*PHŒNIX DYNAMO M'F'G. CO., LTD.	Thornbury Works, Bradford	Dynamo, Bradford	A.B.C. 5th Edition and Private.
PIRELLI, LTD.	144, Queen Victoria Street, London, E.C.	Pirellicon Cent, London	————
*PREMIER COOLER & ENGINEERING CO., LTD	Broadway Court, Broadway, Westminster, S.W.	Precooler, Vic, London	Lieber's, A.B.C. 5th Edition.
PRITCHETTS & GOLD & ELECTRICAL POWER STORAGE CO., LTD.	82, Victoria Street, London, S.W.	Acidulated, Sowest, London	Bentley's or A.B.C. 5th Edition
*REASON MANUFACTURING CO., LTD.	Lewes Road, Brighton	Reason, Brighton	A.B.C. 5th Edition.
*RECORD ELECTRICAL CO., LTD.	Caxton House, Westminster	Infusion, London	A.B.C. 5th Edition and Bentley's.
" " " " "	WORKS:—Broadheath, Manchester	————	————
*REES ROTURBO MANUFACTURING CO., LTD.	Wolverhampton	Roturbo, Wolverhampton	Engineering 2nd Edition, A1 Western Union, A.B.C. 5th Edition.
*REYROLLE A., & CO., LTD	Hebburn-on-Tyne, England	Reyrolle, Hebburn	A.B.C. 5th Edition, Western Union (Universal Edition) and New Business.
*RHODES MOTORS, LTD.	Riverside Works, Doncaster	Rhodique, Doncaster	A.B.C. 5th Edition and Private, Hamilton's Code Condenser.
*RICHARDSONS, WESTGARTH & CO., LTD.	Hartlepool	Richardsons, Hartlepool	A.B.C. 5th Edition, Western Union
SANDYCROFT LTD.	Sandycroft, near Chester	Sandycroft, Hawarden	————
SIEMENS BROS. & CO., LTD.	Telegraph Works, Woolwich	Siemens, Woolwich	A.B.C. 5th Edition, Lieber's, Western Union, Broomhall, Moreing and McCutcheon.
*SIEMENS BROS. DYNAMO WORKS, LTD.	Caxton House, Westminster, S.W.	Siembralos, Vic. London	Moreing and McCutcheon, Lieber's Western Union, A.B.C. 4th and 5th Editions, A1 Engineering.
" " " " " "	38 & 39, Upper Thames Street, E.C.	Siemotor, Cent. London	" "
*SUN ELECTRICAL CO., LTD.	118-120, Charing Cross Road, London, W.C.	Secabilis Ox., London	A.B.C. 5th Edition.
*SUNDERLAND FORGE & ENGINEERING CO., LTD.	Sunderland	Marr	————
*SWITCHGEAR & COWANS, LTD.	Springfield Lane, Salford, Manchester	Control, Manchester	Western Union, A.B.C. 4th Edition.
TUDOR ACCUMULATOR CO., LTD.	5, Central Buildings, Westminster, London, S.W.	Extudorex, London	A.B.C. 5th Edition.
*VENNER & CO.	6, Old Queen Street, Westminster, London, S.W.	Trydan Vic., London	A.B.C. 5th Edition, Western Union, Marconi, Private.
*VICKERS, LTD.	Sheffield and London Westminster, S.W.	Vickers, Sheffield	A.B.C. 5th Edition, Western Union.
WESTMINSTER ENGINEERING CO., LTD.	Victoria Road, Willesden Junction, N.W.	Regency, London	A.B.C. 5th Edition.
WHIPP & BOURNE	Castleton, Manchester	Switches, Castleton, Lancs.	A.B.C. and Lieber's.
*WILLANS & ROBINSON, LTD.	Victoria Works, Rugby	Willans, Rugby	A1, Lieber's, Cole, A.B.C. 4th and 5th Eds., Eng. 2nd Ed.
*WILSON-WOLF ENGINEERING CO., LTD.	Bradford	Energy	A.B.C. 5th Edition, and Private.
*WORTHINGTON PUMP COMPANY, LTD.	India House, Kingsway, W.C.	Pumping, Estrand, London	————

* See announcement in advertisement pages, which are arranged alphabetically.
* Voir les pages des annonces placées par ordre alphabétique.
* Véanse las páginas continiendo los anuncios en órden alfabético.
* Si vedano le pagine degli annunzi posti per ordine alfabetico.
* См. въ объявленіяхъ, расположенныхъ по алфавиту.

Printed for the Proprietors by PERCY LUND, HUMPHRIES & CO., LTD., The Country Press, Bradford, and 3, Amen Corner, London, E.C. 26643